THE FOUNDRY

Vol. 41, No. 3 Cleveland, Ohio, March, 1913 Whole No. 247

Producing Castings for the Automobile Trade

How Aluminum Crank Cases and Gray Iron Pistons Are Molded and Cast by the Rutenber Motor Co.

IN THE development of the automobile, the foundry industry, particularly in the central west, has been subjected to an influence second only in importance to that wielded by the agricultural machinery business and a number of articles have appeared in THE FOUNDRY illustrating the effect of the demands from the automobile trade on the practice in steel, gray iron and malleable foundries. This influence has also extended in other directions and has been particularly potent in the development of shops for the production of both gray iron and aluminum castings in large quantities under a single management. This has come about through the fact that modern automobile motors are equipped with aluminum crank cases to reduce weight, the cylinders being gray iron. One of the typical plants of this character is that operated by the Rutenber Motor Co., at Logansport, Ind. This shop includes a gray iron foundry with a capacity of 50 tons per day, employed in the manufacture of cylinders, pistons and other cast-

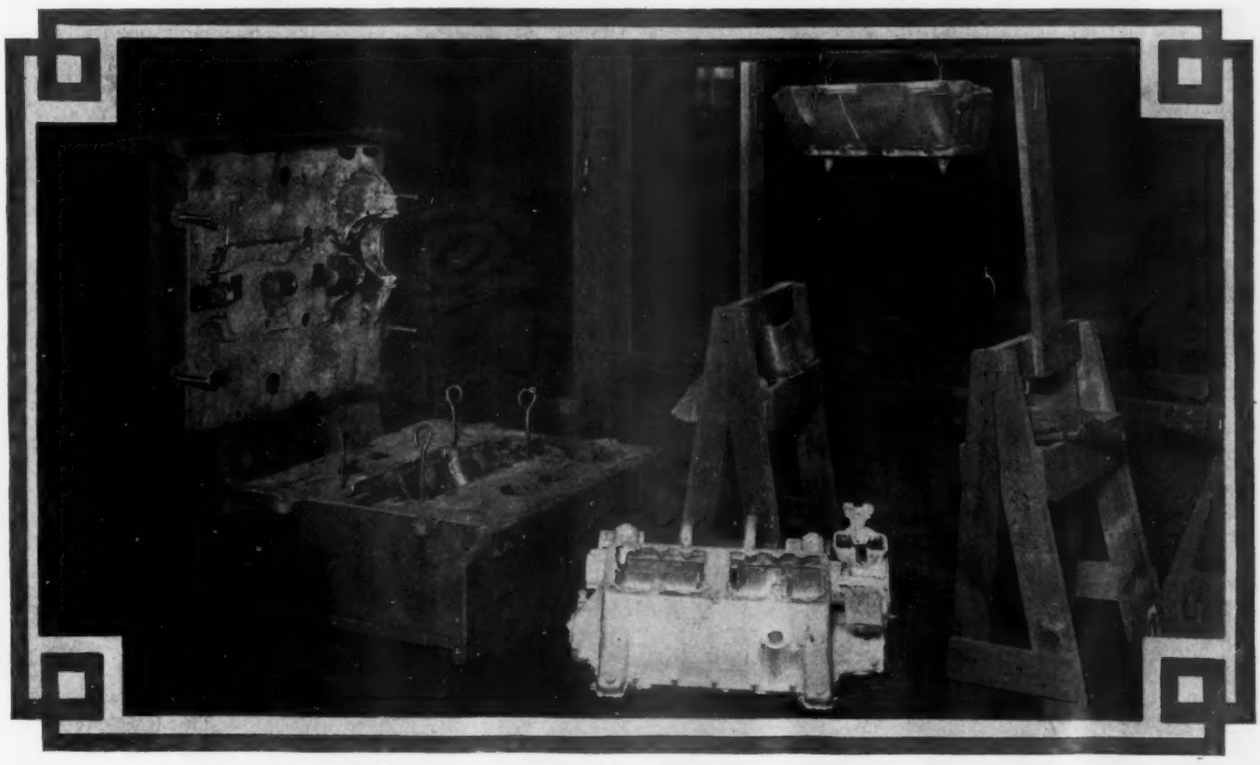


FIG. 1—FOUR-CYLINDER CRANK CASE MOLDED WITH A GREEN SAND CORE

FIG. 2—FOUR-CYLINDER ALUMINUM CRANK CASE MOLDED WITH DRY SAND CORES

ings and an aluminum foundry with a capacity of 10 tons per day for the production of crank cases and other similar specialties.

What is now known as the Rutenber Motor Co. was organized about 13 years ago as the Logansport Foundry Co., and engaged in general jobbing foundry work. About 1903 the name of the company was changed to the Rutenber Mfg. Co. and the character of the organization was also altered, the new management specializing on the production of automobile motors. Through a subsequent reorganization the name was changed to the Western Motor Co. In June, 1912, the present corporation—the Rutenber Motor Co.—was organized and took over the entire business of the Western Motor Co. Two plants are operated, one at Logansport and the other at Marion, Ind. The Logansport plant is devoted entirely to foundry work, while the machining and assembling are executed at Marion.

Although the Rutenber Motor Co. manufactures a number of different models with various features, there are three which may be considered typical. They include a four-cylinder, *en bloc* engine, 3¾ x 5¼ inches, rated at 25 to 30-horsepower, also a six-cylinder triple-twin engine and another four-cylinder motor in which the cylinders are cast singly.

The methods used in molding and casting the crank cases, cylinders and pistons for these three models will be described in this article. The plant in which the work is executed has 60,000 square feet of floor space of which 25,000 feet are occupied by the brass and aluminum foundry, the remainder being devoted to gray iron work.

FIG. 3—CORE ROOM, SHOWING SPECIAL OVEN FOR BAKING CORES FOR ALUMINUM WORK

Aluminum Crank Cases

The aluminum crank cases are molded by hand on the floor from metal patterns. Two general methods are employed, one requiring the use of dry and the other green sand cores. The cylinder and piston molds are made on machines, both the stripping plate and rock-over types being employed.

In either case the first step in the process involves the production of correct patterns. For this purpose a shop has been equipped with machinery for building both wood and metal patterns. In the pattern-making processes there are no unusual features, except that great care must be taken to make the proper shrinkage allowances in the metal patterns.

The crank cases for the four-cylinder, *en bloc*, 3¾ x 5¼-inch motor are rather complicated and, therefore, have been so designed that they may be molded with green sand cores. The metal pattern is finished inside

FIG. 4—MOLD WITH GREEN SAND CORE FOR A SIX-CYLINDER ALUMINUM CRANK CASE

and out and serves also for a core box. This avoids the making of several additional, intricate wooden core boxes and does away with the trouble and losses incident to baking and handling dry sand cores of this character.

Crank Case Mold

The mold, with the pattern still in the sand, but with the green sand core removed, is illustrated in Fig. 1. The job is handled in a flask measuring approximately 48 x 30 inches, the drag being about 10 inches and the cope about 5 inches deep. The flask is built with wooden sides and cast iron ends. This is done not only to increase the durability, but particularly to insure constant accuracy in the fit between the cope and the drag, the pin connections being set in the ends. In Fig. 1, the four lifting rods have been screwed into the pattern preparatory to drawing it from the sand. The main green sand core which is shown suspended on a rod at the right of the drag, is rammed in the hollow pattern after the drag is rolled over and the cope removed. An arbor, of course, is placed under the core to support it when it is drawn out. Small dry sand cores are used for the gear housing and the four supporting arms. The finished aluminum casting weighs 56 pounds and eight molds are made by one man and a helper in a day. If dry sand cores were used throughout, a greater daily production could be obtained, but the economies, thus effected in all probability would be counteracted by the losses encountered in the core room.

Another four cylinder crank case, of somewhat simpler design, in the production of which it is more economical to use dry sand cores throughout, is illustrated in Fig. 2. The mold is shown with the cope removed and the pattern, *A*, drawn out of the sand. The various dry sand cores are in the background. The main core is made in two parts and the gear case core is separate from it. The smaller loose pieces are either fitted to the three large cores, or set in prints in the mold. There are 25 cores in each mold. The casting weighs 80 pounds finished and two molders and a helper put up 15 flasks per day.

The Core Boxes

For this job separate metal core boxes are necessary, one of which is shown at *B*, Fig. 3. This illustration also indicates the general equipment in the aluminum core department. The work is done by hand; considerable fire sand is used in the core mixture while rosin and glue form the basis of the binders. Special care must be taken to produce cores which vent freely and easily if sound cast-

FIG. 5—OIL-BURNING POT FURNACES FOR MELTING ALUMINUM

FIG. 6—A FLOOR OF PISTON MOLDS MADE ON A STRIPPING PLATE MACHINE. THIS REPRESENTS 60 PER CENT OF A DAY'S WORK

ings are desired. In fact the difficulties encountered in getting the molten aluminum to lie quietly against baked, dry sand surfaces is one of the reasons why large green sand cores similar to the one illustrated in Fig. 1, are so frequently employed.

The oven in the aluminum foundry core department is also illustrated in Fig. 3. It has been specially-designed for correct and rapid baking and is of brick construction, 24 feet long, 7 feet high and 6 feet wide. It is fired from both ends and consumes 500 pounds of coke per 24 hours. An arch of checker brick is built into each end. The oven is provided with 45 doors on each side and the core plate supports, which are similar to grate bars, are so adjusted that the core plates may be shoved through from one side of the oven to the other. The cores are baked at a high heat in from 25 to 30 minutes, this practice having been found to produce the most desirable results.

A large six-cylinder crank case mold made with a green sand core, is illustrated in Fig. 4. The open drag is shown in the center of the illustration with the pattern at the right and the casting at the left. In the foreground is the green sand core, suspended for spraying and finishing, on a rod supported by high horses. Several small dry sand cores also are used in connection with this job; they are shown in the foreground in front of the flask. Considerable care must be exercised to insure the proper centering of the cores, thereby accurately preserving the proper metal thicknesses. To this end a number of gages similar to that shown at *C*, Fig. 4, are utilized. This is a depth gage employed to ascertain if the cores come up to the proper height.

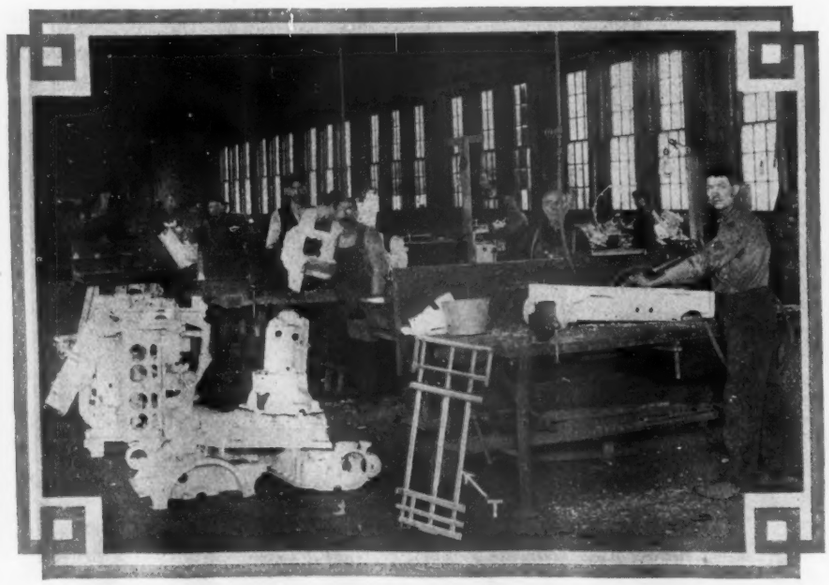


FIG. 7—CHIPPING, GRINDING AND CLEANING ALUMINUM CRANK CASES

Method of Pouring

The metal enters the mold at the bottom through four horn gates, which are bedded deep into the drag. The gates are in pairs on each side of the mold and the casting is poured with two ladles simultaneously. Two large risers extend through the cope and connect with the highest points in the mold. The flask is wood with metal ends and is 56 inches long and 32 inches wide. The drag is 12 inches deep and the cope, about 6 inches. The finished casting weighs 90 pounds and one man puts up two flasks per day. With the assistance of a laborer this production is increased to four flasks a day. The molds are left green and are all surfaced with a pure talc facing.

The aluminum melting equipment includes 10 oil-burning, pot furnaces, Fig. 5, with a capacity of 165 pounds per heat. Approximately 12 heats

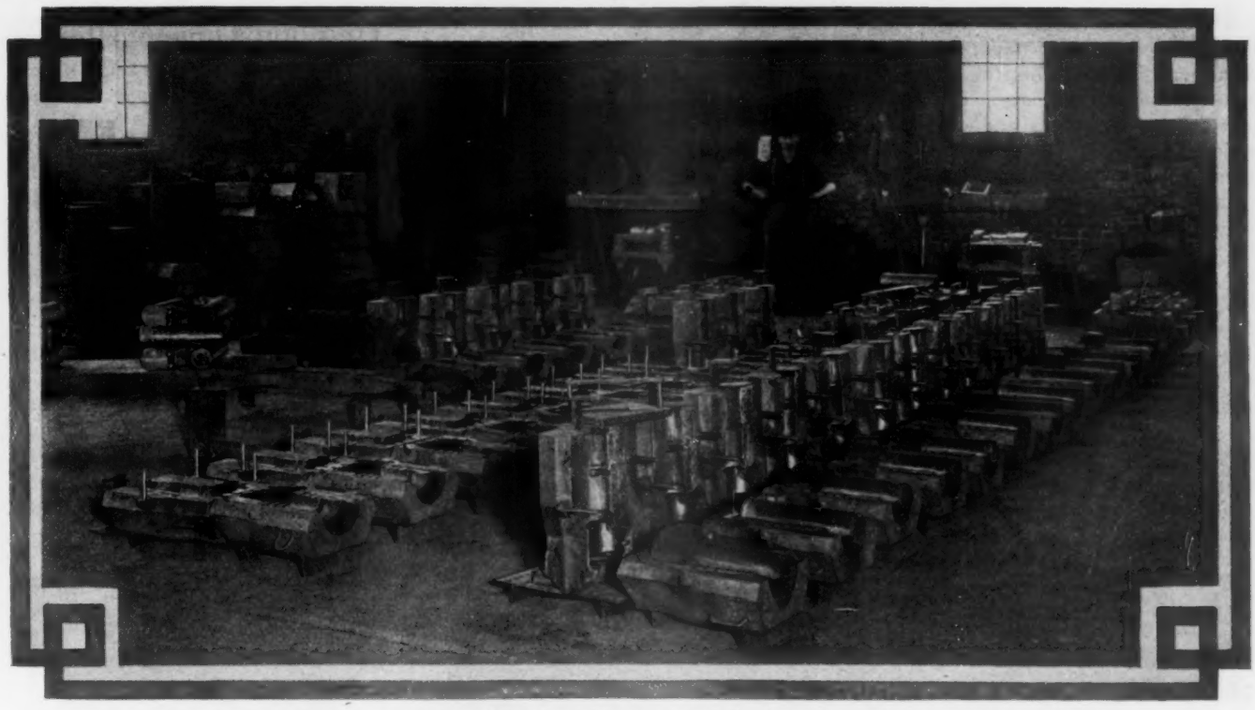


FIG. 8—A FLOOR OF SINGLE BARREL CYLINDERS MOLDED ON STRIPPING PLATE MACHINES

per day are taken off, making the daily production one ton per furnace and the total aluminum melting capacity of the plant, 10 tons per day. The furnaces recently have been re-designed and improved. As constructed at present, the oil-burning nozzle is set close to the shell, the air being carried into the combustion chamber through a pipe surrounding the nozzle. The burners are set tangentially to the furnace wall so that the flame will be given a whirling motion around the pot. The pots are cast with a semi-steel mixture, containing 40 per cent steel scrap and 60 per cent northern foundry pig iron. The object of this mixture is to make a pot which will have a dense structure. The semi-steel pots are said to stand from 150 to 200 heats. In addition to the 10 aluminum pot furnaces, the melting department is equipped with three Rockwell tilting furnaces and with one drying grate. The metal with which the molds are poured consists of a mixture of pure ingot aluminum alloyed with 6 per cent copper and fluxed with zinc chloride.

The rough aluminum crank case castings are removed from the foundry to the cleaning and chipping department, illustrated in Fig. 7. At this point all the fins are removed and the castings are given their final polish. They also are tested for accuracy with a gage or templet, similar to that shown at *T*, Fig. 7, and any defective castings are rejected.

The gray iron department has a capacity of 35 tons per day; the molding floor is 58 x 325 feet and the core room adjacent is 90 x 65 feet. The latter is equipped with three car ovens and also with two stationary shelf ovens similar to the one illustrated in Fig. 4. The iron is melted in a 54-inch cupola.

Making Twin Cylinders

Figs. 9 and 10 illustrate the various steps in the process of making the molds for twin, 3¾ x 5¼-inch cylinders. These cylinders are fitted to the crank case illustrated in Fig. 1. A three-part flask is used and the cylinders are molded with the top end down. The cope and the drag are made on International rock-over machines with vibrator attachment, while a Pridmore stripping plate machine is used for the cheeks. In Fig. 9 the drag pattern is shown on the molding machine, and a finished cope, cheek and drag are shown in the front of the machine, the cope being at the right, the cheek at the left and the drag in the center. The various cores which are used in this mold are in the foreground. Four men put up 50 flasks a day; two

FIG. 9—THREE-PART MOLD FOR DOUBLE TWIN-CYLINDER; THE DRAG IS ON THE ROCK-OVER MACHINE IN THE BACKGROUND

operate the rock-over machines making both copes and drags; the third man makes cheeks on the stripping plate machine and also helps the fourth who sets cores and closes the molds. There are 14 dry sand cores in each mold. The cope is covered by a heavy slab core, *S*, Fig. 9, which is provided with holes through which the barrel cores project, thus holding the latter securely in a central position. The iron enters the mold through drop gates arranged around the periphery of the barrel cores. At *A*, Fig. 10, is a maple gage used to test the setting of the jacket core for height.

Fig. 8 shows a floor of single barrel cylinders ready for closing and the two Pridmore stripping plate machines on which the molds are made may be seen in the background. Special cast iron flask equipment designed to reduce the quantity of sand in each mold to a minimum has been provided for this job. The shape of the flasks, as indicated in Fig. 8, is irregular. With the aid of this equipment, one man is able to put up a floor of 45 molds, including core-setting, in a day of nine hours. The patterns, which are brass, are mounted horizontally on the molding machines, and one machine is used for the production of the copes and the other for drags. As fast as the molds are made they are laid out on the floor as shown in Fig. 8, the drags horizontal and the copes on end. Then the cores are set in the drag half of the mold. The barrel core is set in the mold first, surrounded by the jacket core which is made in halves; next the small pieces are set and jigs and gages are used to center the cores. When the molds are closed they are set on end for pouring and drop gates are used.

Piston Molds

The barrel cores are vented entirely by means of steel rods which are removed as soon as the core is made. The rods leave unusually free and open passages for the gases. This innovation has appreciably reduced the cost of coremaking and has increased the output. The barrel cores are made in pairs on an International rock-over machine equipped with a vibrator.

Fig. 6 shows a floor of 138 piston molds, which is only a part of the day's work, the average production being 225 in 9 hours by one man. Special, cast iron, octagonal flasks are used and the molds are made on the International stripping plate machine shown in the illustration. A single flask is used without a cope, the core, which is dry sand, being suspended from its own flange and is held down by iron weights. The faces of the flasks are machined so that the cores will be centered accurately. The casting weighs 7½ pounds and the molder has the assistance of a laborer in pouring the floor.

The officials of the Rutenber Motor Co. include George W. Bowen, formerly of the Bowen Mfg. Co., Auburn, N. Y., president; C. O. Berger, vice president; A. C. Barley, secretary; J. W. Stephenson, treasurer and general manager; A. Thompson, manufacturing engineer, and J. N. Korhumel, foundry manager.

FIG. 10—A FLOOR OF DOUBLE TWIN-CYLINDERS IN THREE-PART FLASKS

Titanium Copper Alloy

By the use of TiO_2 and CuO, oxides of titanium and copper, Isador Ladoff, Cleveland, has devised a method which he has patented, for alloying titanium and copper, without the employment of such high temperatures as are required for melting and combining the two primary metals. The mixture of the two oxides, with a suitable binder, such as oil, is molded into shape, and either with or without packing in charcoal, the mold is placed in a muffle furnace in a reducing atmosphere of carbon monoxide, at a temperature of from 600 to 800 degrees Cent. At this temperature the reduction starts with the copper oxide and proceeds, catalytically, with the titanium oxide, thus producing the alloy at a temperature below the melting point of copper.

Reverberatory Furnace for Brass

For manufacturing brass on a large scale, Lawrence Addicks, Chrome, N. J., has secured a patent on the use of a reverberatory furnace similar to that now employed for melting copper. A furnace of from 20 to 250 tons capacity in 24 hours may be employed for melting the copper, which is tapped into a ladle in heats of two or three tons, and the proper amount of zinc and tin are added in the ladle. The metal should then be cast into ingots.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form

DATA FOR THE GRAY IRON FOUNDRYMAN

General Rules for Mixing Iron by Analysis.

Silicon softens gray iron, opens the grain, lessens density, weakens, and in excess, causes sponginess.

Sulphur hardens gray iron, closes the grain, increases density, may strengthen, and in excess causes pin-holes and other defects, and may weaken.

Phosphorus increases the fluidity of gray iron, causes brittleness, and in excess, decreases the strength and increases brittleness.

Manganese increases the density of gray iron, it may strengthen, and in small amounts, up to 0.50 to 0.75 per cent, it softens; in large amounts, it hardens.

To get strong iron, keep the silicon as low as possible, without chilling; keep the sulphur between 0.08 and 0.10 per cent; keep the phosphorus under 0.50 per cent, and keep the manganese as high as possible, without chilling.

To get soft iron, keep the silicon high; keep the sulphur low; keep the phosphorus under 1 per cent, and keep the manganese between 0.30 and 0.70 per cent.

To get close-grained iron, keep the silicon as low as possible, without making the iron too hard; keep the sulphur between 0.08 and 0.10 per cent; keep the phosphorus under 1 per cent, and keep the manganese moderately high, 0.50 to 1 per cent.

Relation Between Composition and Thickness of Castings.

For the best results composition must bear a close relation to the thickness of the castings.

Light castings are those having any section less than ½ inch thick.
Heavy castings are those having no section less than 2 inches thick.
Medium castings are all others.

Mixtures for Castings for General Purposes.

Light castings:—Silicon, 2 to 2.50 per cent; sulphur, under 0.08 per cent; phosphorus, 0.60 to 0.90 per cent, and manganese, 0.40 to 0.70 per cent.

Medium castings:—Silicon, 1.50 to 2 per cent; sulphur, under 0.10 per cent; phosphorus, 0.40 to 0.70 per cent, and manganese, 0.50 to 0.80 per cent.

Heavy castings:—Silicon, 1 to 1.50 per cent; sulphur, under 0.12 per cent; phosphorus, 0.20 to 0.50 per cent, and manganese, 0.60 to 1 per cent.

Cupola Changes.

When making mixtures, allowance must be made for the loss and gain of elements in the cupola. While these vary to some extent, they will be approximately as follows:

Silicon, 0.20 per cent loss.
Phosphorus, no change.
Sulphur, 0.04 per cent gain.
Manganese, 0.30 per cent loss.

DATA FOR THE GRAY IRON FOUNDRYMAN

Chemical Composition of Castings for Various Purposes.

Type of Casting.	Silicon, Per cent.	Sulphur, Per cent.	Phosphorus, Per cent.	Manganese, Per cent.	Combined Carbon, Per cent.	Total Carbon, Per cent.
Acid-resistant	1 to 2	UNDER 0.05	UNDER 0.40	1 to 1.5	HIGH	LOW
Acid stills and eggs	1 to 1.5	UNDER 0.05	UNDER 0.40	1 to 1.25	HIGH	LOW.
Agricultural machinery, ordinary	2 to 2.50	0.06 to 0.09	0.60 to 0.80	0.50 to 0.80		
Agricultural machinery, very thin	2.25 to 2.75	0.06 to 0.08	0.70 to 0.90	0.40 to 0.70		
Air cylinders	1 to 1.75	UNDER 0.09	0.30 to 0.60	0.70 to 0.90		3 to 3.30
Ammonia cylinders	1 to 1.75	UNDER 0.09	0.30 to 0.60	0.70 to 0.90		
Annealing boxes for malleable work	0.50 to 0.80	UNDER 0.06	0.10 to 0.20	0.10 to 0.30	2.60 to 2.90	2.60 to 2.90
Annealing boxes, pots and pans	1.40 to 1.60	UNDER 0.06	UNDER 0.20	0.60 to 1		LOW
Automobile castings	1.75 to 2.25	UNDER 0.08	0.40 to 0.60	0.60 to 0.80		
Automobile cylinders	1.75 to 2	UNDER 0.08	0.40 to 0.60	0.60 to 0.80	0.55 to 0.65	3 to 3.25
Automobile flywheels	2.25 to 2.50	UNDER 0.07	0.40 to 0.50	0.50 to 0.70		
Balls for ball mills	0.90 to 1.20	UNDER 0.08	0.20	0.60 to 1		LOW
Bedstead work	2.60 to 2.80	UNDER 0.09	0.90 to 1.10	0.30 to 0.60		
Bed plates	1.25 to 1.75	UNDER 0.10	0.30 to 0.60	0.60 to 0.80		
Bells and hoppers for blast furnaces	1.25 to 1.50	UNDER 0.08	UNDER 0.30	0.80 to 1		LOW
Binders	2 to 2.50	0.06 to 0.08	0.60 to 0.80	0.60 to 0.80		
Blast furnace castings	1.25 to 1.75	UNDER 0.09	0.30 to 0.60	0.50 to 0.80		
Boiler fronts	2.25 to 2.75	UNDER 0.09	0.50 to 0.70	0.40 to 0.60		
Boiler sections	2 to 2.50	UNDER 0.08	UNDER 0.50	0.60 to 1		
Brake shoes	1.40 to 1.60	0.08 to 0.10	UNDER 0.50	0.50 to 0.70		LOW
Car castings, gray iron	1.50 to 2.25	UNDER 0.08	0.40 to 0.60	0.60 to 0.80		
Car wheels, chilled	0.60 to 0.70	0.08 to 0.10	0.30 to 0.40	0.50 to 0.60	0.60 to 0.80	3.50 to 3.70
Caustic pots	1.25 to 1.75	UNDER 0.06	UNDER 0.30	0.60 to 1		2.75 to 3
Chemical castings	1 to 2	UNDER 0.06	UNDER 0.40	1 to 1.50		2.75 to 3
Chilled castings	0.75 to 1.25	0.08 to 0.10	0.20 to 0.40	0.80 to 1.20		
Chills	1.75 to 2.25	UNDER 0.07	0.20 to 0.40	0.60 to 0.90		
Collars and couplings for shafting	1.75 to 2	UNDER 0.08	0.40 to 0.50	0.50 to 0.70		
Cone pulleys	2 to 2.25	UNDER 0.08	0.50 to 0.80	0.50 to 0.70		
Cotton machinery	2 to 2.25	UNDER 0.08	0.60 to 0.80	0.50 to 0.80		
Crusher castings	1 to 2	UNDER 0.09	UNDER 0.40	0.60 to 0.80		LOW
Crusher jaws	0.80 to 1	0.08 to 0.10	0.20 to 0.40	0.80 to 1.20	HIGH	
Cutting tools, chilled iron	1 to 1.25	UNDER 0.08	0.20 to 0.40	0.60 to 0.80		
Cylinder bushings, locomotive	1.25 to 1.50	UNDER 0.08	0.30 to 0.50	0.70 to 0.90		
Cylinders	1 to 2	UNDER 0.10	0.30 to 0.60	0.60 to 1		LOW
Dies for drop hammers	1.25 to 1.50	UNDER 0.07	UNDER 0.20	0.60 to 0.80		LOW
Diamond polishing wheels	2.50 to 3	UNDER 0.07	0.20 to 0.40	0.30 to 0.50		LOW
Dynamo and motor frames, bases and spiders, large	2 to 2.50	UNDER 0.08	0.50 to 0.80	0.30 to 0.40		LOW
Dynamo and motor frames, bases and spiders, small	2.50 to 3	UNDER 0.08	0.50 to 0.80	0.30 to 0.40	0.20 to 0.30	LOW

Faster Melting

By W. J. Keep

Question.—Our cupola is lined to 34 inches and the melt averages about three tons an hour. We would like to increase this output, if possible. The blast is nine ounces and the blast pipe 12 inches in diameter. The charges consist of 500 pounds of coke on the bed and from 80 to 90 pounds between the subsequent charges of 1,000 pounds of iron. We use about 50 pounds of limestone per charge, but find that the slag does not flow freely.

Answer.—The speed of melting depends upon the time required to burn the coke. It is essential to burn all of the coke charged and for this reason the coke charges should be made as small as possible to obtain hot iron. It might be advisable to gradually reduce the coke charges 10 pounds at a time. Your coke bed seems too small, and, when you begin charging, the coke should extend 15 inches above the top of the tuyeres. If you use 90 pounds of coke per charge, your melting ratio will be 7.6 to 1 and if you use 80 pounds per charge, your ratio would be increased to 8.2 to 1. This is good melting for so small a cupola. After you have reduced the coke charges as small as possible, an increase in the volume of your blast will burn the coke more rapidly. While nine ounces is a fair pressure for a cupola of this size, 14 ounces would do no harm. It is probable that you are using a poor quality of limestone, and if it contains from 75 to 80 per cent of lime, 20 pounds of this flux would be ample.

Aluminum and alloys of aluminum should be poured at a low temperature to obtain sound castings.

Fire Clay for Steel Mixtures

Question:—Kindly advise us which is the best grade of fire clay to use for steel foundry work and how to mix a facing for steel, including the proportions of the different sands.

Answer:—Any good grade of fire clay can be used providing it is smooth and free from grit. A facing commonly employed consists of a barrowful of silica sand, 1 shovelful of flour and from 1½ to 3 level shovels of fire clay. Mix thoroughly by milling, adding molasses water to insure the proper consistency for use in molding.

Another mixture consists of silica sand, 10 parts, and fire clay, 1 part. Temper with molasses water containing 1 pint of black molasses to 20 pints of water. Mill thoroughly.

A dark skin on brass castings frequently is caused by sulphur in the metal.

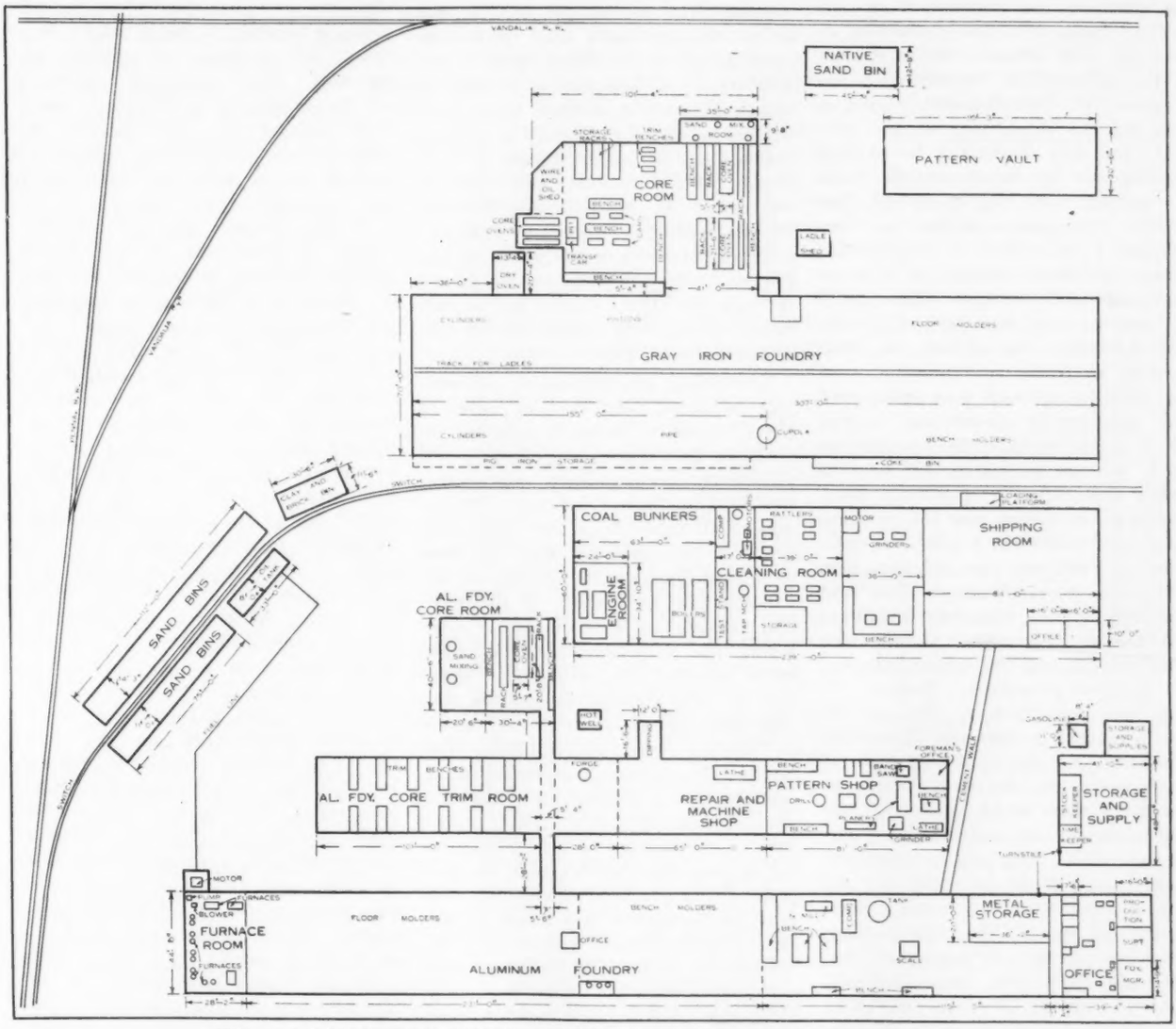


FIG. 11—PLAN OF THE FOUNDRY OPERATED BY THE RUTENBER MOTOR CO.

The Electric Refining Furnace for Cast Steel

Various Types of Melting Mediums Are Briefly Described and Their Operation is Discussed in an Elementary Way

IN A paper presented before the Birmingham branch of the British Foundrymen's Association, J. H. Stansbie discussed, in an interesting manner, the application of the electric furnace to the production of iron and iron alloys. The first part of the address was devoted to a description of electro-magnetic induction for the production of the current, and was illustrated by several experiments for the benefit of those not familiar with the subject of electricity. The speaker showed how resistance to the flow of the current caused electrical energy to convert itself into heat energy which could be utilized for metallurgical work, and described the system of units used in electrical measurements, stating that the kilowatt-hour represented the quantity of electrical energy which would increase the temperature of 22 pounds of water, 100 degrees Cent. Describing it in a more practical way, he stated that 155 of these units, theoretically, would be sufficient to melt one ton of cast iron with only a small loss. The first practical form of the electric furnace was the arc, the most simple type consisting of two fire bricks hollowed out to form a crucible. Such a furnace was exhibited by the speaker and was used to describe the mode of operation. He explained that to produce the arc, the two carbons or electrodes must touch when the current is turned on, and afterward they are separated. The furnace displayed, used a current of 74 volts, the arc space having been 1½ inches. Continuing, he said, "When the carbons in an arc lamp are connected momentarily and then separated, the rush of current develops so much heat that some of the carbon is volatilized and forms a bridge of vapor across the gap between them through which the current passes. The resistance of this vapor is so great that much heat is generated and a temperature approximating 3,500 degrees Cent. is attained in the space between the carbons. The minimum pressure that can be used to form an arc is 30 volts for alternating and 40 volts for direct current. The region in the vicinity of the carbons is the hottest space it is possible to produce by any means at present. Heavy currents under low pressure are the best for the generation of heat."

Describing the principal types of electric furnaces the speaker explained that the simple arc furnace in its most generally used form, consists of a vessel lined with a refractory, carbonaceous conducting material, with a carbon block suspended above the charge in such a manner that it can be raised or lowered. This constitutes the positive electrode. In starting the furnace, the electrode is lowered until an arc is produced between the material and the electrode and the current passes through the actual charge in the furnace, which, when melted, is run out of the bottom of the furnace.

Continuing his description of electric furnaces, the speaker said in part: "Electric furnaces may be divided in four classes as follows: Arc, resistance, arc-resistance and induction or transformer furnaces. Examples of all these types have been used for iron and steel melting. To Heroult must be given the credit of advancing the application of the electric furnace to steel-making. After laying the foundation of the aluminum industry, he turned his attention to steel melting, having the arc-resistance principle in mind, which he applied very successfully. The bed of this furnace consists of a refractory, non-conducting material, usually dolomite lime. The upper part of the furnace consists of silica bricks and the outer casing of iron plates, which are separated to prevent the formation of a magnetic circuit. The electrodes consist of solid blocks of carbon which are connected with the leads from the source of current and are suspended to permit of raising and lowering them.

Melting Operation

"The melting operation, with a cold furnace, is commenced by introducing a part of the charge of pig iron and scrap, and then lowering and raising the electrodes to form arcs between their lower ends and the surface of the charge. The current passes through the charge from one electrode to the other, the resistance being largely furnished by the poor contact of the separate pieces of the charge, thus developing the heat necessary to melt the material. When the charge is melted, a slag is formed by the addition of lime and iron ore; this, when melted, forms a blanket of liquid matter into which the electrodes are slightly immersed. Heat is mainly developed by the resistance of the slag, which decreases as its temperature increases. Its conducting power is greatest at the point of contact with the electrodes. It is possible to arrange the distance between the electrodes, so that part of the current will be conveyed by the slag and part by the bath of metal. In this way the temperature of the metal bath can be controled. The electrodes do not come in contact with the metal, otherwise the latter would absorb carbon and this constitutes an important factor in the refining. Other features are the readiness with which the composition of the slag may be varied, so as to be either oxidizing, neutral, or reducing, and as it can be removed and a fresh slag formed, the refining can be carried to the highest limit. After refining, additions can be made and alloys of any desired composition can be produced.

"The Societe Electro-Metallurgique Francais, makes ferro-chrome, ferro-tungsten, ferro-nickel, and ferro-silicon in its Heroult furnaces at Froges and La Praz, France, and Dr. Heroult states that he can make steel practically free from silicon, sulphur and phosphorus, containing from 0.02 to 2 per cent of carbon. Such metal can be cast sound and is of tool steel quality. Furnaces up to 5 tons capacity are in use.

"In the Girod modification of the Heroult furnace the current is induced by means of a system of multiple electrodes distributed around the arch, so as to pass more or less uniformly through the bath. This results in a more uniform distribution of the heat.

"It is well known that a liquid conductor contracts in cross-section when an electric current passes through it. This is due to electro-magnetic force, which acts from the circumference to the center of the column, thus producing a pinching effect. In the construction of his furnace, Hering has taken advantage

of this, by replacing the usual solid electrodes by tubes constructed in the bed lining of the furnace and surrounded with refractory material. These are known as resistor tubes, and are closed at the bottom by hollow, water-cooled plugs, which are connected with the current supply. There are usually two of these tubes, but with 3-phase current three tubes may be used. To operate the furnace, the resistor tubes must be filled with molten metal and must be connected with each other by the molten bath. When the current is passing, the pinch-effect causes the metal to rise up in the center and to fall down at the sides, and in this way a circulation is maintained which not only keeps the bath of molten metal in motion, but also assists in the distribution of heat. Directly over the tubes the surface of the slag is lifted up as though the metal underneath were being bumped up against it. This makes the bath appear to be boiling, although no bubbles escape. Such an action must evidently assist the refining.

The Nathusius Furnace

"A further modification of the Girod is the Nathusius furnace. One of this type, having a capacity of 6 tons, has been in constant operation for 18 months. This is an arc-resistance furnace in which three-phase current is utilized. The current circulates through both the bath of metal and the dolomite lining, which is somewhat conductive at a high temperature. This insures a more uniform temperature throughout the charge and appears to be the principal advantage of the furnace.

"The electric furnace, as a simple melter, cannot be used economically, so that when part of the charge can be run into the hot furnace, a considerable saving can be effected. This has been carried out with the partly refined metal from the mixer and also from the Bessemer converter, but it involves tapping the metal and its transference by ladle to the electric furnace. The two processes, have, however, been combined in one vessel by Verdon, Cutts & Hoult of Sheffield, Eng., whose furnace constitutes a marked improvement.

"Very few arc furnaces of large size are in use and of these the Stassano has proved the most successful for iron and steel. It is more expensive to operate than the furnaces of other types and has a more limited application. However, it has been used by the Italian government for the manufacture of gun steel. The furnace is circular in cross-section and has a dome roof. It is lined with refractory material and the carbon electrodes enter about half way between the bottom and the roof. They are controlled by a gear which regulates their movement in the chamber of the furnace. Tap holes are provided for metal and slag, the former near the bottom of the hearth and the other half way between it and the electrode openings. The whole structure is mounted on an axis slightly inclined to the vertical, so that one side of the hearth is always a little lower than the other when it is in rotation. The electrodes rotate with the chamber and contact with the power leads is maintained by an arrangement of brushes connected with the axis at the top of the chamber. The charge is heated entirely by radiation from the arc space and the side walls of the chamber. Furnaces of various sizes have been built.

The Induction Furnace.

"The construction of the induction type is unlike the arc furnaces, as it is operated without electrodes. It is, in its original form, a step-down transformer, and was first introduced by Ferranti. The most successful of the early furnaces of this type is that constructed by Kjellin, at Gysinge Bruk, Sweden. A step-down transformer, in principle, consists of a continuous ring or core of soft iron enclosed in a core consisting of many turns of insulated, thin, copper wire. This primary coil is surmounted by a coil of thick, insulated copper wire, which forms the secondary circuit. If light alternating currents at high pressure are sent through the primary coil, heavy currents at low pressure are induced in the secondary coil when its terminals are connected. The ratios between current and pressure in the two coils follow a simple law. Thus if the primary coil consists of 1,000 turns of wire and the secondary of 10 turns, and if the primary carries a current of 100 amperes at 3,000 volts, then the induced current in the secondary would be 10,000 amperes at a pressure of 30 volts. There are, of course, energy losses in the transformer, but these are quite small. As previously stated, heavy currents at low voltage are best adapted to heat production resistance. If the secondary coil consists of one coil only and its cross-section is limited so as to offer sufficient resistance to the passage of the heavy induced current, the possibility of melting it becomes evident. This is the principle of the induction furnace in which the metal to be treated forms the secondary coil, of one turn, in the transformer.

"The hearth in the Kjellin furnace is circular and consists of an annular space in the masonry lined with either acid or basic material. It is provided with a tap hole and a cover which is made in sections, so that any part of the hearth can be readily inspected. A massive soft iron core, rectangular in form and made up of thin plates, is arranged so that one side passes through the center of the circle, of which the hearth forms the circumference. This is surrounded by the primary coil, the terminals of which are connected to the leads from the generator.

Operating the Furnace

"When operating the furnace the coil must be protected against the heat of the masonry, and this is done by surrounding the coil by a closed chamber through which cold air can be forced from a compressor. Many objections have been urged against this form of furnace, but it has been in successful use for 12 years, and for some kinds of work is undoubtedly the best. The furnace must be started with a ring of molten metal in the hearth, so that when the primary current is turned on, transforming may commence at once. The heat thus generated in the ring increases its temperature, and additions of cold metal may be made until the full charge is added. Refining is carried on by additions of ore and slag-forming material, and when this is finished, additions of ferro-alloys may be made for the production of special steels. The charge in the hearth is caused to rotate rapidly by the electro-magnetic forces at work.

"An idea of the power required to opereate such a furnace may be gained from the statement that a furnace of 4,000 pounds can be worked by an alternating current of 80 to 90 amperes at 3,000 volts, which is stepped-down to 30,000 amperes at 7 volts in the hearth. The energy thus absorbed is equal to 282 horsepower."

The United States government has placed its 1913 order for its annual supply of pure nickel with the United States Nickel Co., New Brunswick, N. J. The metal supplied is refined from New Caledonian ore, which is remarkably low in cobalt and is almost entirely free from copper, arsenic, sulphur and phosphorus. On account of its uniform purity, always analyzing above 99 per cent, it is used by the United States mint.

Annealing Steel Castings

In a paper presented before the London, Eng., branch of the British Foundrymen's Association, entitled "Steel Castings," H. Brearly dealt with the growth of crystals in steel, and the effect of heat treatment thereon. He maintained that the microscopic study of the changes in the crystallization of steel, produced by heat treatment, proved that a steel casting is less reliable before, than after annealing, and that, in consequence, all steel castings should be annealed before being placed in service, irrespective of the process by which they were made. Annealing, he defined as the reheating of steel castings after they have been taken from the sand, followed by slow cooling.

Heating to Low Redness

The most important purpose of the annealing operation should be to break down entirely the large intercrystalline bounderies, thereby permitting the crystals to re-form under more favorable conditions during the subsequent cooling. After this treatment, the material so far as structure alone is concerned, may be compared to an overheated forging. The very coarse crystalline structure has disappeared, fragility tests give high and quite concordant results, and the fractured surface is no longer to be distinguished in appearance from that of a cogged billet.

If the castings are heated only to low redness, the typical structure is only partially obliterated, the shrinkage stresses are relieved, but the crystalline grains are little if any smaller, and their internal structure still bears some resemblance to its former appearance. Annealing is also desirable for another reason quite independent of shrinkage stresses. The interior surface of a sand mold generally contains carbonaceous matter, either in the molding material or as plumbago, paint, or in some other form. The hot steel comes into contact with this carbon, or the gases that arise from it and is hardened, the action of cementation being most marked in those places from which cracks can most easily be started. As the bulk of the metal may contain less than 0.3 per cent of carbon, the surfaces that have been in contact with the mold may contain as high as 1.5 per cent carbon and on that account the castings are of inferior quality unless the difficulty is corrected by suitable annealing.

The hard exterior of an unannealed casting may possess some commercial value as a wearing surface, where the shape is extremely simple.

During the many hours that the casting is exposed at high temperatures to the oxidizing temperature of an annealing furnace, the carburized envelope disappears and is replaced by an envelope of carbonless metal, which is accompanied by a re-arrangement of the internal crystalline structure. Considerable doubt exists as to whether castings of delicate structure and complex outline, can be kept to shape at the high temperature required to break down the coarse primary structure. Difficulties of this kind must be overcome separately as they occur. There are, however, sometimes hindrances in the steel itself of a very serious nature which can, according to certain authorities, be overcome, but not by any method of heat treatment at present known. This is the presence in special form, of non-metallic impurities, which may be grouped under the head of slag enclosures. In the mass of a casting such enclosures, here and there, may not prove serious, in fact few large castings or forgings are entirely free from these blemishes, but in a test bar they would spoil the results absolutely.

Slag Enclosures

What is more serious than the segregated slag area, because more widespread, is the tendency under certain conditions for envelopes of non-metallic impurities to form around the crystalline grains. These always weaken crystalline cohesion and are difficult to deal with. A slag globule within the primary crystal is comparatively harmless. When, however, the slag forms as a film between the grains, it is not easy to set a limit to the troubles that follow, as a very slight disposition to pull as the casting contracts, results in the formation of a crack.

It has been stated that films or silico-sulphide streaks, as they are sometimes called, will ball-up when annealing the casting; but the examples the author has seen were unfortunately not of that variety and it may be seriously doubted whether the balling-up of an actual film has ever been accomplished by any form of heat treatment a casting might be expected to survive. Having located between the primary crystals, the films persist as films. As often as the casting may be heated the films remain, and during the subsequent cooling, act as nuclei around which the free ferrite gathers as it falls out of the solution.

Tonnage Per Square Foot of Foundry Area

The floor area per ton of castings produced in German, Austrian and Belgium foundries was discussed by E. Munk, in a recent issue of *Stahl und Eisen*. The average floor area per ton of castings of foundries in the United States, from the author's investigation, is much lower than that of the average foreign foundries, from which data were received. This is due to the fact that in many of the casting shops of the United States continuous operations show a large tonnage for a minimum floor area. A large foundry in Chicago producing machinery castings required from 43 to 134.5 square feet of molding floor space per 100 tons of yearly output, depending upon the size and weight of the castings. On the other hand, a plant at Nurnberg, Germany, which is well-designed and efficiently-operated, requires 323 feet of floor space per 100 tons. On the other hand, the plant of the American Locomotive Co., Schenectady, N. Y., has an annual output of 100 tons for a floor space varying from 172 to 237 square feet. Contrasted with this is 807 square feet per 100 tons required by the Sachsishen Maschinenfabrik, in Chemnitz. Both foundries are engaged in the production of similar castings, such as frames for locomotives, steam engine sections and heavy machinery parts. The foundries of the International Harvester Co., Chicago, have an annual output of 100 tons on a minimum of 258 square feet and a maximum of 280 square feet. On the other hand, the McCormick plant of the Harvester company, at Chicago, has a production of 100 tons annually for each 62.4 square feet of floor area. The latter shop is operated continuously and is one of the most efficient in the United States. Compared with this shop is the foundry of Gebr. Sulzer, Winterthur, Switzerland, which likewise produces a large tonnage of agricultural machinery castings, but for each 100 tons of yearly output, a foundry floor area of 646 square feet is required.

The annual convention of the office managers and selling engineers of the American Blower Co., Detroit, was held at the Hotel Pontchartrain, of that city, Jan. 23 to 25. Engineering, salesmanship, administration, works management and production were discussed and it was the prevailing opinion of the sales representatives that the outlook for an increased volume of business during 1913 is unusually bright.

Easily-Applied, Common Sense Cost System-II

The Method of Distributing Direct and Indirect Foundry Costs Are Discussed and a Classification of Work Recommended

By O O Brace

COMPLETE analyses of the elements entering into a foundry cost system are contained in the accompanying tables. These are the fundamental divisions of production and distribution necessary to the final determination of the profit and loss resultant. We will discuss these divisions in order, recording in minute detail, the various items of cost included in each; the simplest and most direct method of recording each item, including forms that have been found by actual experience to promote rapid and economical handling of the clerical work and the completion of the final cost reports at a minimum expense. At the end of this discussion an amplified analysis will be given with a graphic representation of each detailed item of cost and its relation to the elementary division shown on this chart.

Objects to be Attained

In elaborating on the method of cost accounting it will be treated with two objects in view:

First.—A complete monthly report of foundry operations, showing profit or loss on each class of castings produced, the month's work being treated as a unit.

Second.—A complete profit and loss statement upon each individual order, to be made upon its completion or at any time during its production.

Classification of Castings

In analyzing the output of any foundry it will be noted that the castings may be grouped into various classes of work in respect to weight, style, cores, etc. In a typical jobbing shop one will find heavy floor castings, light uncored work, light cored castings, shop work such as flasks and repair parts, cylinders, pistons, flywheels, stove plate, miscellaneous jobbing work, agricultural castings, and many other classes of work. If you will take your own shop and classify its output you will find many of the enumerated classes of work and no doubt others peculiar to your own business. You may have one large contract for machinery castings or other work, which forms a very important portion of your output, and which will affect very heavily your profit and loss account.

Analysis of Foundry Production and Distribution

A.—Cost of Production.
1.—Direct or basic costs.
1a.—Metals actually used.
2a.—Molding cost.
3a.—Coremaking cost.
2.—Indirect or burden costs.
1b.—Burden on tonnage.
2b.—Burden on molding.
3b.—Burden on coremaking.
4b.—Selling expense.

Note.—Item No. 2 must include all labor, materials and expenses not included in direct costs.

B.—Value of Production.
1.—Gross value of output.
2.—Value of castings returned from or credited to customers for defects.
3.—Net value of foundry output.

C.—Profit or Loss.
1.—Net value of output.
2.—Total cost of output.
3.—Net profit or loss.

Detailed Analysis of Indirect Costs

Indirect Costs.
1.—Foundry burden.
1b.—Burden distributed upon tonnage.
1b.—Transportation.
2b.—Night crew or cleaning foundry floors.
3b.—Yard labor, unloading and piling iron, coke, etc.
4b.—Cupola cost.
5b.—General flask expense.
6b.—Cleaning and chipping.

Note.—There are occasions when these last two items must be treated as direct costs, or when they may be more accurately distributed as a molding burden. These cases usually arise when some part of the output differs greatly from the regular work.

2b.—Burden distributed as a percentage of molding labor.
1b.—Power, except that used by cupola and core room.
2b.—General shop expense.
3b.—Repairs to power plant.
4b.—Repairs to power-driven equipment.
5b.—Repairs to buildings.
6b.—Repairs to all other equipment except flasks.
7b.—Shop superintendence.
8b.—Office expense.
9b.—Executive salaries.
10b.—Interest.
11b.—Taxes.
12b.—Insurance.
13b.—Depreciation.
14b.—Pattern repairs and expense.
15b.—Molders' supplies.

3b—Core room burden apportioned as a percentage of labor actually engaged in making cores.
1b.—Power.
2b.—General shop expense.
3b.—Repairs to power plant.
4b.—Repairs to power-driven equipment.
5b.—Repairs to buildings.
6b.—Repairs to all other equipment.
7b.—Shop superintendence.
8b.—Executive salaries.
9b.—Office expense.
10b.—Core ovens.
11b.—Interest.
12b.—Taxes.
13b.—Insurance.
14b.—Depreciation.
15b.—Repairs and expense on core boxes.

4b.—Selling Expense.

To be apportioned usually to various jobs arbitrarily in the proportion of the actual expense incurred in their sale.

The purpose of such a classification is to give you an opportunity to determine from your monthly reports, which are the strong, profitable jobs, and which are the undesirable ones upon which you may be really losing money. This is the sole aim to be kept in mind in arranging the basis of your cost system.

With the classes carefully arranged, if any of them prove unprofitable, you can determine from the individual order costs, whether there is in this group any profitable and desirable work, or whether your selling prices on the whole class are lower than they should be. By careful comparison and elimination the possibilities of management for profit are tremendous and the showing at the end of the manufacturing year will be most gratifying.

Classification of Work

In arranging a classification of your work—the aim being the determination of each group—it follows that the work must be so grouped that

The grouping reflects accurately the three varying items of direct cost, and so provides a true basis for the apportionment of the indirect cost.

The groupings are sufficiently uniform to provide a guide for the determination of a sales value for that group.

In grouping castings they should be considered with respect to weight, molding and coremaking cost and similarity of design. Thus, light castings should never be grouped with heavy sections, nor cored with uncored work. The only exception to this rule is a large contract billed at a flat price, when for convenience sake, it is best to assign to the contract an entire class and thus obtain the costs on the whole order.

Following the principles outlined, one will experience no trouble in arranging a classification which will be adapted to his special requirements and which will give all of the desired information.

After a classification has been made, each group should be numbered and lists should be made up showing in detail the system to be followed. These should be distributed to all employes whose work is affected by the cost or order system. It is highly im-

portant that those entrusted with even the minor details of the system be thoroughly familiar with its basic principles.

By numbering the classes you can add to or eliminate them at will, as the necessities of your business may dictate. As your business grows or laneous job floor work, small orders for jigs, etc., and heavy work generally of more difficult nature than is included in class 4.

The problem of basic classification of output is a simple one and will cause no trouble if the rules given are complied with. It is merely a question of studying one's output and separating it upon logical lines.

We will now discuss the most simple, accurate and inexpensive way of obtaining complete records of direct costs, for each class of castings and also for each individual order; how this can be accomplished with minimum clerical expense, and with safe-

PATTERN NO. A 567 | FOR Speedway Car Co. Brooklyn, N.Y. | NO. ORDERED 2000 | DELIVERIES ½ Sept. ½ Oct.
ORDER NO. 1923 | SHIP TO Newark Machine Co. Newark N.J. | CLASS NO. 7
DATE 9-11-11

DATE	NO. MADE	BALANCE	SCRAP	MOLDING	DATE	NO. MADE	BALANCE	SCRAP	MOLDING	DATE	NO. MADE	BALANCE	SCRAP	MOLDING
9-20	230	1770	41	3 25										
9-21	300	1470	51	3 25										
9-23	325	1145	56	3 25										
9-24	325	820	50	3 25										
9-25	325	495	46	3 25										
9-26	325	170	76	3 25										
Sunday		970	970											
		490												
9-27	325	165	41	3 25										
		76												
		241												
9-29	325		35	3 25										
			76											
		Out		* 26 00										

FIG. 1—SHOP ORDER, 5 x 8 INCHES

This consists of four forms which are padded, the first three consisting of paper for manifolding, being printed on one side; the fourth copy is card stock and is printed on two sides, the reverse side being ruled with vertical lines.

you engage in new lines, you will require additional groups, and classification is thus made possible to any desired degree of detail without interfering in the least with the harmonious operation of your cost accounting system.

Jobbing Foundry Classification

The following classification is used by a jobbing foundry melting 30 tons a day:

1.—All shop, flask and repair castings.
2.—Atlas furnace contract.
3.—Grate bars.
4.—Flywheels and plain, heavy castings.
5.—Light, uncored castings (bench work).
6.—Light cored castings (bench work).
7.—Pistons.
8.—Piston rings.
9.—All floor work not included above.
10.—Cylinders.

Class 1 is self-explanatory.

Class 2 is a large contract requiring about one-fourth of the shop capacity, taken at a flat price per pound, and for that reason it was highly desirable to know its exact standing each month.

Class 4 is intended to include all plain, heavy, low value work, with the exception of grate bars which are grouped in a special class.

Classes 7, 8 and 10 are specialties to which a large area of the shop is devoted and for that reason must be watched closely.

Class 9 is intended for all miscel-

PATTERN NO. A 567 | FOR Speedway Car Co. | NO. ORDERED 2000
ORDER NO. 1923 | SHIP. TO Brooklyn, N.Y. Newark Machine Co. | DELIVERIES ½ Sept. ½ Oct
DATE 9-11-11 | VIA Electric Package Newark N.J. | CLASS NO. 7 | AVERAGE WT. 6#

DATE	NO. SHIPPED	WEIGHT	BALANCE	DATE	NO. SHIPPED	WEIGHT	BALANCE	DATE	NO. SHIPPED	WEIGHT	BALANCE	MISC.
9-23	* 100	603	1900									*9-22
	120	715	1780									Exp. 100
9-25	350	2125	1430									Guard
9-26	430	2589	1000									telegram
10-1	1059	6400	out									*
		12435	*									

FIG. 2—CORE COST RECORD, 5 x 8 INCHES

This is the third copy of the shop order and contains a record of the core cost

guards insuring protection against loss or carelessness by any employe. This discussion will begin with the receipt of a customer's order and will cover in detail the necessary shop orders, molding and coremaking costs, shipping records, billing and sales book.

With these will be shown suggested forms which have been found practical. The principles of application, however, are important, and the forms used will depend upon the individual necessities or desires.

Following the receipt of any order, the first step should be to have the price, if given, approved by the general manager or whoever is held responsible for sales prices and this O. K. should be noted upon the face of the order.

The order should next go to the shop order clerk. He should first stamp on the face of the order the class number to which each item belongs. For entering the order a quadruplicate shop order blank is most convenient, one copy to be sent to the pattern storage and sent into the foundry with the pattern; one to the superintendent for his information; one to the core room and the fourth to be retained by the order clerk and upon it to be recorded daily, the number of pieces cast, the number defective, the balance due on the order and the molding cost. A convenient form for this record is shown in Fig. 1. This form is 5 x 8 inches and the fourth copy is made of heavy cardboard, printed on both sides. This is the copy retained by the order clerk and can be filed readily in a card index tray, and will insure maximum speed in keeping this part of the cost record.

The order clerk at the same time fills out a core cost card when the work requires cores. This card, shown in Fig. 2, is also 5 x 8 inches and should be filed in a separate tray. The method of making entries on each will be explained later.

After initialing the order the clerk sends it to the shipping department, where it is entered on a form, Fig.

3. This card is also kept in a card tray for prompt and easy reference.

The order is then sent to the billing clerk where entry is made of the pattern number, class number and selling price on a form, shown in Fig. 4. These cards are 3 x 5 inches and it is most convenient to file them under firm names, and sub-index them by pattern numbers where the quantity warrants.

To properly enter the order by this method requires only a few minutes and the result is that every department of the shop is in possession of every bit of information needed for the safe, speedy and accurate filling of the order.

In many shops the volume of business does not necessitate the number of employes mentioned, but the functions are always present. The records can be simplified so that the order clerk can do the work without materially increasing his duties.

Molding and Coremaking Record

Either from time slips or from a daily floor report, a record must be made of each man's daily production, showing in addition to the number made the actual time spent by him on each job.

Time slips are the more accurate. When used, however, they *must not be made out at the end of the day.* They should be given to each operator in the morning, that he may note upon them during the day the exact time when he starts on each pattern. The best results are obtained by furnishing each man with a clip attached to a board in which to insert the time slip so it will be before him at all times.

The accuracy of these records is of the utmost importance as they form the vital basis of all other computations.

The timekeeper must make daily recapitulations of the entire molding and coremaking cost, showing the totals for each class. From these, at the end of the payroll period, the proper charges easily are made of the molding and coremaking costs for each class. No forms for these records are given as they will vary greatly with each foundry. The change involved from present methods is usually only slight. The most important feature is to secure accurate records of the time a molder spends on each job.

PATTERN NO.	FOR	
A567	Speedway Car Co.	
SELLING PRICE 45¢ cwt.		ORIGINAL ORDER NO. 1923 – 9/11/11
CLASS 7	AVERAGE WEIGHT 6#	CORED
REMARKS AND CHANGES	PRICE OK.	GEN. MGR.

FIG. 4—PRICE CARD, 3 x 5 INCHES
This is printed on card stock for the billing department records.

PATTERN NO. A 567 — FOR Speedway Car Co. — NO. ORDERED 2000
ORDER NO. 1923 — SHIP TO Brooklyn N.Y. — DELIVERED ½ Sept.
DATE 9-11-11 — Newark Machine Co. Newark N.J. — ½ Oct. — CLASS NO. 7

DATE	NO. MADE	BALANCE	SCRAP	CORE COST	DATE	NO. MADE	BALANCE	SCRAP	CORE COST	DATE	NO. MADE	BALANCE	SCRAP	CORE COST
9-18	300	1700		2.75										
19	300	1400		2.75										
20	300	1100		2.75										
21	300	800		2.75										
23	300	500		2.75										
24	300	200		2.75										
		600	Scrap allowance											
		800												
25	300	500		2.75										
26	300	200		2.75										
27	300			2.75										
		Out		$24.75										

FIG. 3—SHIPPING ORDER, 5 x 8 INCHES
This order is card stock and is printed on both sides

In the shipping room two objects are sought:

First, an absolutely correct record of every casting that is shipped from the plant.

Second, securing a responsible receipt that will prove delivery of the shipment beyond any chance of dispute.

Orders must be accurately entered with a record of the shipment and the shipping records must be made so as to permit of their careful analysis and recapitulation in the sales book.

The best way to avoid mistakes in the shipping records is to have the castings counted just prior to shipment. Enter this record immediately upon the permanent shipping form used. It is a mistake to mark the figures on some temporary record and afterward re-copy them. Make the entry directly on this record. If the castings are bulky and pass over the scale in several lots, enter each lot as weighed. Do not list them elsewhere and then enter only the totals. Lax rules form a prolific source of lost revenue. The entering of weights directly on the shipping bills may seem a small item, but if adhered to conscientiously, it will eliminate 99 per cent of the mistakes in shipping records.

Rechecking the Count

After making this entry, if the castings are to be crated or packed, it is best to have the *count only* rechecked. You will recall that the price card on file with the billing clerk, shows the average weight of the casting, and it is his duty in figuring the billing to check all items sold by weight and to see to it that the shipping weights are correct. Hence the importance of an accurate count.

When the castings are not to be packed, a competent man should take the shipping record as made and check, piece by piece, the various items as they are loaded.

If this comprehensive checking is

DAILY RECAPITULATION ----FOUNDRY SALES Sept. 19 1911

SHIPPING BILL NO.	WEIGHTS CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	CLASS 8	TOTAL WEIGHT	VALUES CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	CLASS 8	TOTAL VALUE
186	700		800		1251		2190		2390	8 00		18 00		62 55		109 60		117 50
190	500								2551	2700								102 55
183		980			2410			1290	4680		29 40			96 40			179 00	254 80
TOTAL	700	980	800		3661		2190	1290	9621	30 00	29 40	18 00		158 95		109 50	179 00	474 85

FIG. 5—FORM FOR THE DAILY RECAPITULATION OF SALES

carefully carried out, it will be surprising how few complaints will be received of inaccuracy in the shipping department. Also, one's peace of mind will not be disturbed over underbilling of shipments, an error which is prevalent.

A convenient shipping form is shown in Fig. 6. When the items have been entered on the shipping bill, the shipment should be listed on the order card and the balance brought down.

This shipping bill is in triplicate and works equally well in book form, from which only two copies are detached, the third being permanently bound. If used in the register, one copy should roll into a locked compartment and two copies should be detached.

For local shipments both copies are given to the teamster, the original to be signed by the customer and returned, the copy to be left with the shipment. On out-of-town shipments triplicate bills of lading are used.

The shipping bills should all be numbered consecutively and *must all* be turned in to the billing clerk and accounted for. Even if one is spoiled it must be retained. The billing clerk should have a small order register, or memorandum book with corresponding numbers listed in it. When the bills are figured and checked, and permanently bound in the daily sales book, the billing clerk must check off the number of every bill so bound and note any that are missing. The third copy in the shipping room will give the contents of any that are missing. A duplicate then should be made, and after it is permanently bound in the daily sales book it should be checked from the order register.

The checking of shipments is a subject that cannot be over-emphasized. You will use every known means to protect your cash, and you should insist on just as much care in the handling of the merchandise which you are exchanging for cash. The amount of loss through laxity at this point would astonish many managers if it were pointed out to them. The trouble is that they seldom hear of this class of mistakes.

SHIPPING BILL

191

SOLD TO

VIA

ORDER NO	NO PIECES	DESCRIPTION	CLASS	WEIGHT	PRICE	VALUE
	NO					

FIG. 6—SHIPPING BILL, 5 x 8 INCHES

This is filled out in triplicate, either bound into books or for use in a register. The second copy is on thin paper for office record only; it need not be printed.

Daily Sales Recapitulation

The bound record of the daily sales should be recapitulated, item by item, upon a sheet giving the weight and value of all castings shipped in each class and these daily totals should be summarized at the end of the month. For this purpose it is convenient to use a multiple-column journal such as can be purchased cheaply, or a special form, similar to that shown in Fig. 5 can be used.

It should be remembered that the monthly recapitulation is a record of sales only and not of production and it is upon production only that costs are to be figured. To obtain a record of the month's production it is necessary, at the close of each month, to have an inventory made of all castings made, but not shipped. The record of the good castings made the last day of the month can be obtained from the foundry reports, and combined with a list of all that are on hand in other parts of the shop. This list, after being classified, is added to the sales total for the month. From these figures are deducted the balance of castings shown to have been on hand at the first of the month and the defective castings which have been credited to customers. The resultant figures give the actual production for the current month.

Application of Chemistry in the Plating Room-I

The Apparatus and Solutions Required Are Enumerated and Described, With Practical Suggestions for Their Use

By E P Later

PROBABLY none of the ordinary arts makes as intimate use of chemical principles as that of electroplating. It is essentially a chemical process and is, or should be, conducted along such lines, but it is surprising sometimes, to find how little real chemical knowledge many good platers possess, and the extent to which they fail to avail themselves of the help they might derive from even a moderate amount of it. No doubt the plater does pick up a good deal of rough and ready information, but it is too apt to be disconnected and without system.

Value of Scientific Methods

On the other hand, apparently not very much has been done to translate chemistry into plating terms so the fault does not lie entirely with the workman. The general run of textbooks is of doubtful value when it comes to the question of giving him the necessary directions for going ahead and making the simple analyses and exercising the definite and certain control over his solutions which makes all the difference in the world between the man who knows and the man who merely guesses and trusts to luck. In these days of strenuous competition and exacting requirements there is not much room for the man who never knows from one day to the other what his solutions contain, nor how they are going to plate. Aimless and hap-hazard *doping* is gradually giving way to exact and scientific operation. The plater's art is no longer the mystery it once was; the most excellent formulae may be had for the asking and everywhere it is being placed under the same business-like methods and given the same careful scrutiny that other manufacturing processes receive.

It is, therefore, the purpose of this series of articles to present as simply as possible, some short methods for determining the various constituents of the commoner plating solutions. By their use it is possible for any plater to know just what his solutions need and how much, so that they may be maintained at their highest efficiency with slight attention. As a preliminary comment, it may be said that all of these methods are not absolutely exact and are not intended for use where a high degree of accuracy is required. At the same time when performed with reasonable care and precautions, they will give results which are close enough for all practical purposes.

To get good results in any line of work requires a certain amount of care and attention to details and this is especially true in chemistry. Carelessly made solutions, dirty apparatus and slipshod manipulation cannot fail to give incorrect results.

If possible, a small room apart from the plating room should be selected for the laboratory. Only a small space is required and often this may be found in a corner of the office. The main requisites are a well-lighted place, fairly clean and free from dust. It should be provided with a bench or work table and, if possible, should have running water, both hot and cold, and sewer connections, although these are not strictly necessary. If gas is available, so much the better; if not, an alcohol lamp may be used for heating whenever this is desirable.

Necessary Apparatus

In stocking his laboratory, each plater will have to be guided largely by how deeply he cares to go into things, the analyses he wishes to make and the money he cares to spend for such purposes. Ingenuity plays a good part, too. Some people can get surprising results from a few simple pieces of apparatus; others require, or think they do, more and better tools. Most of the pieces enumerated herewith will be found indispensable.

Balance:—This is of so much service that it may well be considered necessary, even though it will not be directly called for in any of the methods which follow. A good balance, sufficiently accurate for all ordinary purposes, may be obtained from any good chemical supply house at a cost not exceeding $75.

Beakers:—One, or better two, *nests* of these should be obtained, as they are not expensive.

Bottles:—A dozen or more wide-mouthed bottles should be purchased for use in collecting and keeping samples, chemicals, etc.; six or eight-ounce is a convenient size.

Several large bottles of a gallon or so capacity will be needed for standard solutions. Those in which pure acids and ammonia are sold serve excellently.

Indicator Bottles

Two or three bottles for indicators will also be needed. They may be purchased or easily made by sticking an ordinary fountain pen filler through the cork, so as to permit of the indicator being added drop by drop.

Burettes:—These are long tubes graduated in centimeters and provided with a glass stop cock, so that any desired quantity of liquid may be easily drawn off. Some forms of this instrument are fitted with a short piece of soft rubber tubing carrying a short piece of glass tubing drawn down to a fine bore, instead of a stop cock. The flow of liquid is then controlled by a small metal clip, which presses the walls of the rubber tube together, but may be opened by gentle pressure with the fingers. The latter form of burette is somewhat cheaper, but has certain disadvantages, so that it is better, on the whole, to purchase the other form. They may be obtained from any supply house at slight cost. At least two, and, preferably, three should be obtained. This number will not only eliminate the necessity of thoroughly cleaning the burette and changing solutions every time a different test is made, but it will also prevent the delay and inconvenienre which would result if the only burette on the job were accidently broken.

Burette Holder:—Some form of burette holder will be needed. This may be made by any one possessing a little ingenuity, but I would suggest that a ring stand, with three or four rings and two clamps, be bought. This will then give a means of supporting beakers and other vessels while they are being heated.

Burner:—A Bunsen burner or alcohol lamp will come in very handy for

heating solutions and for various odd uses.

Funnels:—A couple of funnels, one about 3 inches in diameter and the other a little larger, will be needed for pouring and filtering solutions and samples.

Pipettes:—These are glass tubes having the middle part blown into a bulb and used for measuring out any desired quantity of liquid. A ring or mark around the stem indicates the point at which it contains the rated amount of liquid. They can be obtained in various sizes and I would suggest that two 5 cubic centimeter, one 10 cubic centimeter and one 25 cubic centimeter pipettes be purchased.

Spot Plate:—A porcelain spot plate to be used when outside indicators are employed will prove to be of service, although a sheet of white paper may be substituted for it without difficulty.

Stirring Rods:—Several pieces of glass rod, 4 or 5 inches long and with the rough ends rounded in a gas flame, should be prepared for stirring solutions, during titrations and similar uses.

Volumetric Flasks:—These are of various sizes and are accurately graduated to contain a certain quantity of liquid. Any supply house can furnish them and it would be best to get one of 250 cubic centimeters and one of 1,000 cubic centimeters capacity.

Wash Bottle:—A handy wash bottle may be made as follows:

A glass tube 6 or 7 inches long should be softened in a gas flame and bent to an angle of about 60 degrees, approximately 4 inches from the end, the other end being then passed through a large rubber stopper until it protrudes an inch or so. Another tube, about 1 foot in length, should be softened in the flame and bent to an angle of 30 degrees at a point 4 inches from one end; the other end should then be passed through the cork until it nearly touches the bottom of the wash bottle. A nozzle may be made by drawing a piece of tubing out to small bore in a flame, cutting it in two after cooling, then rounding the ragged edge in the flame and connecting it to the end of the long tube by a piece of soft rubber tubing.

Solutions and Reagents

As the operator becomes more familiar with the work and the kind of analyses required, other useful pieces of apparatus will suggest themselves and may be obtained as desired.

In the methods to be described, use is made of what are known as volumetric solutions. These differ from other solutions mainly in the fact that they contain a certain definite and known amount of reactive substance per unit volume of liquid. Since all chemical action takes place in accordance with well-known laws and in certain definite mathematical ratios between the two reacting substances, it is easily seen that if we know how much active material a certain solution contains and how much of it is required to combine or react completely with a known amount of another solution, it is very easy to calculate exactly the amount of active material in the latter. All of these methods are based on this principle.

To facilitate calculations and insure uniformity, volumetric solutions are made up in concentrations which are functions of the molecular weight of the salt employed. This may be briefly explained by stating that a salt is composed of two or more elements, using the word in its chemical sense. Each of these elements has its own specific weight, called the atomic weight. Obviously then, the *specific* or *molecular* weight of a salt is the sum of the atomic weights of the elements composing it.

Atomic Weight

These terms must not be confused with measures of quantity or mass such as grams, ounces or pounds. All elements are composed of molecules, which in turn are composed of two or more atoms. The hydrogen atom is the lightest known and, therefore, may be arbitrarily called 1, and the atomic weight of all other elements compared with it. Thus, oxygen has been found to have an atom which is very nearly 16 times heavier than the hydrogen atom, therefore, its atomic weight is said to be 16. In fact, the atomic weight of oxygen is now almost universally used as the standard, instead of hydrogen. In the same way sodium has an atomic weight of 23, chloride 35.5 and so on. Going a step farther, sodium chloride or common salt is composed of one atom each of sodium and chlorine; therefore, its molecular weight is the sum of these, or 58.5. If now, 58.5 grams (1 gram = 1/28 ounce, approximately) were dissolved in water and the whole diluted to 1,000 cubic centimeters (roughly, 1 quart), we would have a *normal* solution of sodium chloride. For our purposes a normal solution may be considered as one which contains the molecular weight of the compound in grams, divided by the hydrogen equivalent, dissolved in 1 litre (1,000 cubic centimeters) of water. Thus, nitric acid has a molecular weight of about 63; since it has only one replaceable hydrogen atom, its hydrogen equivalent is 1; therefore, a normal solution of nitric acid would be made by diluting 63.02 grams of the acid to exactly 1,000 cubic centimeters.

Molecular Weight

In the case of sulphuric acid, we find the molecular weight is about 98. It contains two replaceable hydrogen atoms, however, so we would take one-half the molecular weight or exactly 49.05 grams to make up a normal solution. By taking 1/10, 1/20, 1/50 and so on of the normal weight, we would make solutions 1/10 normal, 1/20 normal, 1/50 normal, etc. These are generally written $\frac{N}{10}$, $\frac{N}{20}$, $\frac{N}{50}$. Space does not permit of further discussion of these solutions; if the operator desires more information he should refer to some of the standard textbooks on quantitative analysis. Tables of atomic and molecular weights may also be found there.

A little reflection will now show that 1 cubic centimeter, say, of one $\frac{N}{10}$ solution is exactly equal to 1 cubic centimeter of any other $\frac{N}{10}$ solution. An $\frac{N}{10}$ solution of any acid will neutralize its own volume of $\frac{N}{10}$ solution of any alkali.

Whether or not standard solutions should be made or purchased from the supply houses, will have to be decided by each plater for himself. A good house can supply any kind of solution accurately standardized and ready for use, so that the operator is relieved of all trouble and misgivings, and does not need a balance. On the other hand, there is a certain satisfaction in knowing that you can make your own solutions and be independent. Besides, quite a little money can be saved by so doing, as those purchased are more or less expensive. If a chemist or druggist friend is available, he could probably be called upon to give a good deal of help in preparing them.

One economical way of doing it is to buy or get in some way a small quantity of each of the standard solutions needed and then make up your own standards, using the originals only to check your own. With a little experience a person can become quite expert at making good solutions in this way, without the aid of a balance. Further directions regard-

ing the preparation and standardization of solutions will be given under the different methods in which they are used.

Indicators, as the name implies, are substances which, by their behavior under certain conditions, serve to show in a solution the presence or absence of other reacting compounds. Thus, with acids and alkalis, use is made of certain organic substances which indicate the presence of free acid or free alkali by a change or absence of color. For example, litmus shows blue with alkalis and red with acids; phenol phthalein is a reddish pink in presence of alkalis and colorless in presence of acids.

There is a large number of such indicators, but our work will require only litmus, phenol phthalein, methyl orange and congo red. All of these may be purchased ready made, but it is better to buy the dry powders and dissolve them in small quantity as needed. At least two other indicators will be required, silver nitrate and uranium nitrate. Their preparation and use will be discussed in subsequent articles of this series.

DIFFICULTIES OF THE PLATING ROOM

The Reason Why and the Remedy

Cleaning the Nickel Bath

We have a nickel bath located directly underneath a large line shaft hanger, and recently while the shop mechanics were examining this hanger, a large amount of oil, which had accumulated in the reservoir under the bearing, was carelessly emptied into the nickel bath. Believing the solution ruined, we ordered it thrown away, but owing to the illness of the foreman, this has not been done. We have been informed that it may be saved, but no practical method has been suggested. The entire bath and equipment are spattered with oil. Kindly let us know if it is possible to save the solution. Should we wash the anodes and fittings in benzine?

The solution may be cleaned and worked as satisfactorily as before. Skim off the bulk of oil with any kind of a skimmer, which will collect it before removing the anodes. Then carefully take out the anodes and set them aside until the bath is prepared to receive them again. Strip the tank of all fittings and clean them by first wiping off the bulk of the oil and then scouring with boiling potash. Do not use benzine under any circumstances. After cleaning the fittings, rinse and dry them. While this is being done by a boy, sprinkle moderately coarse, dry, soft wood sawdust over the entire surface of the solution and immediately proceed to remove the sawdust with a gauze skimmer. The wood particles will absorb the oil and if removed quickly, will not settle in the solution. After the surface is freed from sawdust, spread sheets of common newspaper over it and remove by slowly pulling to one end of the tank, raising and clearing the tank end. Repeat this operation a few times and every vestige of oily film will be removed. Wash the tops of the anodes in a weak lye solution, using a brush and pumice. When entirely free of oil, immerse in a dilute solution of sulphuric acid and water. When all neutralizing action ceases, remove and rinse in clean, running cold water and suspend in the bath. Neutralize all washed wooden fittings, such as rod covers, etc., in the same manner and no ill effects will result from the shower of oil. Nickel baths located underneath bearings or machinery of any kind are in constant peril of just such accidents and precautions should be taken to avoid them.

French Gray Finish

We do a large amount of French, gray-finished, silver work and have used various methods of producing the black. Recently, we tried a black nickel solution and found the color excellent for our purpose, but the deposit is too difficult to relieve. Is there any known method of producing a softer black nickel suitable for this class of work?

A black nickel which will be found soft and easily relieved may be prepared as follows: Dissolve plastic carbonate of copper in a quantity of liquid ammonia until no more will dissolve. Also dissolve plastic carbonate of nickel in a like quantity of liquid ammonia until the same results are obtained. Then make a saturated solution of carbonate of soda and water, and to five gallons of the carbonate of soda solution add 2½ quarts of the carbonate of nickel solution and five ounces of the carbonate of copper solution. The soda solution may be prepared hot and allowed to become cold before adding the two ammoniated solutions. The solution should be operated cold with from 3½ to five volts tension, using a clean, old nickel anode or strips of clean sheet iron as the anode.

Tiffany Finish

I am desirous of obtaining a formula which will produce the finish known as Tiffany green. This, I believe, is a corroding process and is not a pigment finish.

The Tiffany green solution consists of 10 ounces of sulphate of copper, 12 ounces of sal-ammoniac, 5 ounces of sodium chloride, 2 ounces of acetic acid (28 degrees), 1 ounce of chloride of zinc and 1 ounce of glycerine to 1 gallon of water. On solid copper or copper-plated surfaces, the effect is a dark verde. A heavy deposit from an acid copper bath is best suited for the production of a verde by this method, as the copper is pure and the color of the finish is better. Uneven surfaces finish to better advantage than plain surfaces and the copper deposit should not be scratch-brushed, but left in matte condition, as when removed from the plating solution. When used on brass, either copper-plate or immerse the brass in a hot solution of sal-ammoniac, ½ pound, and sulphate of copper, ½ pound, to 1 gallon of water. This will produce a dark coating. Allow this to dry in the air. Then apply the Tiffany green solution either by stripping with a brush or by immersion. The work is then allowed to dry, which requires from 12 to 15 hours. Usually the color thus obtained lacks sufficient depth and a second treatment is required. The second drying may be effected in a heater and can be continued until all moisture has been expelled. The high lights are then relieved with a stiff brush and the article is given a uniform surface by gently buffing on a soft wheel. If a luster is desired, lacquer and wax. If a dull finish is preferred, use flat lacquer. You will find that a few trials will be necessary before you get good results, as

the production of a really good verde requires skill. Very good results are obtained by hanging the article in an atmosphere of steam for some time after the second treatment and then drying in the air. The color may be deepened by passing the piece through clean, cold water and slowly drying. When preparing the articles to receive this verde, do not fail to obtain a heavy copper deposit, as much depends on this point. In fact, the preparation and manipulation are of first importance. The solution will attend to the chemical changes easily.

Glazing Polish for Commutators

Can you recommend a good glazing polish for use on a plating dynamo commutator? Various compositions we have used with success on motors, have not been satisfactory on the plating dynamos.

It is much more difficult to glaze a commutator equipped with copper gauze brushes than when provided with carbon brushes as on motors. Many compounds which prove efficient on motors are useless on a plating dynamo. The following, however, gives splendid results if used sparingly. Applying any polish too freely is bad practice: Boil 1 ounce of flowers of sulphur in 1 pint of water containing 4 ounces of caustic potash. Continue the boiling until the solution is well dissolved. Then stir in a quantity of lard oil until an emulsion of thick consistency is obtained. Allow this to cool and mix it with equal parts of pulverized flowers of sulphur and electrotypers' graphite to make a stiff paste. Apply to the commutator with a clean cloth free from grit.

Bronze-Plating Steel Tubes

We are bronze-plating steel tubes, 4 feet long by 2 inches in diameter, to the ends of which are attached malleable iron castings, about 4 inches square. The bronze bath deposits several different colors on each tube and the tubes are colored differently than the castings. The solution registers 7 degrees on the hydrometer. We have zinc dissolved in ammonia, but believe the addition made the deposit blister.

Ammonia serves no useful purpose in a bronze bath and we strongly advise freeing the solution of the ammonia by boiling, after which, test the solution by plating a tube. If the color is not uniform, increase the metallic strength of the solution by the addition of copper carbonate dissolved in potassium cyanide. By such additions, increase the density of the solution to at least 15 degrees Baume, and then add about ½ pint of strong cyanide solution to every 50 gallons of solution. Free cyanide is required to avoid the various colors on the tubes, but must not be greatly in excess, as the castings then will be more liable to blister. The excess of cyanide also aids in keeping the anodes clean. After these additions, test again by plating a tube and if the color is quite uniform, make a further addition of 2 ounces of carbonate of soda and 1 ounce of bisulphite of soda to each gallon and stir well. This addition will improve the conductivity of the solution and the deposit should be clearer. Regulate the distance between the cathode and anode so that the castings are not plated lighter in color than the tubes. This may require a distance of 10 inches, or even more. If by thus regulating the current, the results are not satisfactory, copper the entire piece in a cyanide copper bath before bronzing, and a perfect deposit should be obtained. Keep the copper content of the bath high with just enough free cyanide to avoid the several colors. Operate the bath warm for richer tones.

Electro-Tinning Solution

We have been trying to electro-tin cream separator parts and have met with poor success. The solutions we have tried deposit slowly and are so complicated that when anything goes wrong we are obliged to call in an expert to help us out. We want a simple tin solution for rapid, heavy work and would prefer one operated cold.

Proceed as follows and you will be quite successful: Dissolve 20 ounces of caustic potash in 10 gallons of hot water and add 20 ounces of chloride of tin, commonly called tin salts. After a thorough stirring, add 3 pounds of potassium cyanide and continue to stir until the tin chloride is dissolved and a clear solution is obtained. Then allow the liquid to cool and filter well to remove any iron which might possibly be introduced with the tin chloride. The caustic potash has no direct bearing upon the plating quality of the solution, as it is used only to aid in the preparation of the solution. It neutralizes any free acid contained in the tin chloride and should be prepared as here directed. Were it not used and acid were present in the chloride, the potassium cyanide would cause hydrocyanic acid gas to be expelled and the potassium cyanide would be neutralized to some extent and thus a portion of its value would be, lost. Therefore, it is expedient to employ the caustic potash when preparing the solution. In operating the solution, either cast or rolled pure tin anodes should be used. The anode surface must be as large as conditions will permit and a current of about 3 volts tension is required. If desired, the solution may be operated hot by using about two volts and scratch-brushing the deposit more frequently, as it then deposits very rapidly and becomes rough unless brushed. The deposit under either condition is very white and is suitable for nearly all commercial purposes.

Oxidized Finish on Gray Iron

We would like to know how to apply an oxidized finish on gray iron castings and we would appreciate some information regarding the necessary material and equipment for a plant of this kind.

To produce an oxidized finish on gray iron castings, it is necessary to first copper-plate them in a cyanide copper solution unless a plain, unrelieved finish is desired, in which case a black nickel deposit or possibly a phosphoric black would suffice. Usually, however, when an oxidized finish is specified, the oxidized copper surface is required. The copper deposit need not be very heavy, unless for protective reasons, but it must be sufficiently heavy to withstand the effects of the potassium sulphide used to produce the black color. A 10 or 15-minute deposit in a hot solution, or a 30-minute deposit in a cold solution should be satisfactory. If the castings are porous and spotting-out results after coppering or oxidizing we would advise a 30-minute deposit in an acid copper solution following the cyanide deposit, or the use of compressed air to remove the cyanide solution prior to oxidizing.

A good cyanide copper solution for such work consists of potassium cyanide C. P., 6 ounces; carbonate of copper (plastic), 3 ounces; bisulphite of soda, 2 ounces; carbonate of soda, 1 ounce, and water, 1 gallon. This solution may be used either hot or cold, but best results are obtained at a temperature of about 120 degrees Fahr. When preparing the solution, dissolve the potassium cyanide in one-half the quantity of lukewarm water and dissolve the two soda salts and the carbonate of copper in the remaining water. Then mix the two solutions and stir well. Boil for about one-half hour to complete the mixture. Electrolytic copper anodes are preferable, although sheet copper may be employed. If the copper deposit is produced heavy and becomes matte or dull, a scratch-brushing operation will be required to produce a surface suitable for oxidizing, but if the sur-

face is not too coarse, this operation may be dispensed with.

To oxidize the coppered castings, the following solution is employed: Two ounces of German potassium sulphurette, commonly called liver of sulphur, dissolved in 1 gallon of water, to which may be added a small piece of sal-ammoniac which aids in retaining the sulphur and thus prolongs the life of the dip; but as the material is cheap and the solution easily prepared, there is no economy in so doing, as freshly-prepared solutions give best results. If the black is to be relieved to expose the copper in spots, an addition of ¼ ounce of sulphate of ammonia to each gallon will render the coating softer and more easily relieved. The relieving is done on a felt wheel, or if a lustrous surface is desired, the entire casting is scratch-brushed dry after oxidizing, using a fine, brass wire, circular brush on a lathe. The castings are immersed in the oxidizing solution and the operation is repeated until the desired black is obtained; then the castings are rinsed and dried by use of hot water. Too much liver of sulphur in the solution causes the too rapid precipitation of the sulphide and the coating is non-adherent; therefore, use as weak a solution as possible to obtain the required effect and bring the color up slowly.

Necessary Equipment

The requirements for the work include a small dynamo of about four volts, supplying at least 50 amperes, or of capacity sufficient to treat the amount of work you desire to handle at one time. A rheostat to regulate the current, one sheet iron tank for the copper solution, one sheet iron tank for cleaning solution of lye or potash, one wooden scouring trough for scouring and dipping and a barrel may be used for hot water rinsing. Copper anodes, rods, tubes, connections and connecting wires, a crock for the oxidizing dip and chemicals for solutions, brushes for scouring and ground pumice. If a polished surface is required, the following should be added: One polishing lathe, wheels, emery, glue and glue pots. Naturally, a few extra incidentals will crop up as you progress. In purchasing a dynamo, it is always advisable to allow for a possible increase in business, as other necessary additions may be made to the plant from time to time at a comparatively small expense.

THE AMERICAN PLATER

Equipment and Mangement of Nickel Baths---IV—By S W Rowsbar

TO CONSIGN a nickel solution to the sewer simply because repeated endeavors to correct an unusual condition prove unsuccessful may be an easy method to overcome difficulties, but it requires no skill on the part of the plater. In fact, a *plater* would not do such a thing. Such a man would be better termed an *operator*. Many cases have been known, however, where this has been done rather than make an inquiry. These men seldom rise in the estimation of their employers, but continue to prove stumbling stones in the path of their own progress. Before a nickel bath, composed of the simple salts of nickel and water only, may give excellent deposits, modern conditions have actually forced the progressive plater to resort to the use of various reagents and methods which were deemed harmful 20 years ago. Experience, however, has proven that the ideas are less injurious than the old school of platers imagined and gradually the acquired prejudice is being put aside. Dark nickel deposits do not necessarily indicate a solution contaminated by copper nor is a turbid, light gray, green-colored solution always a result of the malicious introduction of soap or other alkali. If the nickel deposit is dark, streaked, mottled or otherwise defective in tone or uniformity, attend to the electric current and metallic strength. When these points are corrected and the difficulty continues, improve the conductivity of the solution either by correcting the possibly poor anode surface or the contact of the same with the tank rods. The bath may have been prepared with distilled water to insure purity, but pure water alone is a very poor conductor of electricity and such a bath, with insufficient metallic strength, is just as liable to cause annoyance in many respects as a bath prepared with tap water strongly impregnated with iron.

Regardless of the presence of the usual impurities in the water, if the nickel solution operated with the proper current produces dark nickel, one of the previously-named causes may be responsible. A solution contaminated by copper usually indicates the fact beyond a doubt to the close observer and the effect is distinctly different. To remedy the dark deposit, dissolve 4 ounces of sulphate of nickel for each gallon of solution and add to the bath. If this addition brings the color up to the required whiteness, let well-enough alone. The bath may be too acid after this addition, in which case neutralize the free acid. Very often dark deposits may be corrected by electrolyzing the solution for several hours with the full voltage of the dynamo. When time is the most important factor to be considered, we may use from 2 to 3 ounces of either sodium chloride, sal-ammoniac or ammonium sulphate to each gallon, and if the conductivity is satisfactory, but the deposit too gray, reduce the current slightly and add 2 to 3 ounces of boracic acid to each gallon. This softens the deposit and makes it tough and white. The acidity of the bath is not materially affected by boracic acid in small quantities, as it is very mild and frequently is employed as an eye wash.

A new nickel solution prepared from the following formula will produce a splendid deposit from the start and will continue to do so if the metallic strength is maintained: Double nickel salts, 8 ounces; single nickel salts, 3 ounces; sal-ammoniac, 2 ounces; boracic acid, 2 ounces, and water, 1 gallon. A new bath composed of double sulphates and water not infrequently gives trouble from peeling in addition to the dark color, especially if the solution stands in excess

of 6 degrees Baume. To remedy, reduce the density to 4¼ or 5 degrees and add the conducting salts, after which operate the bath with a current tension of not to exceed 2 volts. Nickel anodes sometimes contain a percentage of cobalt and the presence of this metal is indicated by the reddish shade of anode surface after a few hours rest in the bath. The color is frequently attributed to the presence of copper. The small amount of cobalt is not harmful and does not affect the deposit. Sometimes the nickel solution is covered with a glaze-like scum after remaining at rest over night. The scum is more pronounced during cold weather and upon the surface of concentrated solutions, such as are employed for mechanical plating machines, and is sometimes regarded as an indication of the presence of grease, but instead, it consists mainly of iron in the form of cuprous hydroxide. If this is undisturbed, it eventually changes to the cupric condition and settles to the bottom of the tank, aiding in the formation of the slime found when cleaning the solution. A gauze skimmer will remove the scum. The mud or slime at the bottom of the solution consists mainly of the basic sulphate of iron and very small quantities of tin and carbon. Nickel solutions containing ammonia in excess, not only produce a dark deposit, but the metal is brittle and readily peels. Ammonia has a tendency to make nickel hard and when soft, easily buffed deposits are desired, the bath should be watched to avoid an excess of ammonia. The alkalinity of the bath from natural causes may be avoided in a large measure by the proper management of the bath.

Gray Nickel Deposit

If for any reason, the nickel deposit is too bright or lustrous, and a gray or matte deposit is desired, place a small quantity of magnesia carbonate in a piece of cheese cloth and repeatedly immerse and squeeze the carbonate in the solution. It will produce a milky turbidness. Then clear the solution with a few drops of sulphuric acid and as soon as the solution settles, the bath is ready for use. Additions of sulphuric acid should be made cautiously, as the maximum reaction in a nickel bath after such an addition does not take place immediately. A period of from 24 to 48 hours is usually required to enable the bath to regain its normal balance or reach that point where excessive acidity is determined by imperfect deposits. An excess of sulphuric acid often causes a nickel solution to foam. This is more liable to occur with freshly-prepared baths and the foaming is frequently attributed to an excess of current.

The system of circulating or agitating the electrolyte has been attended with considerable success, as by this system, the time taken for the operation of nickel-plating has been reduced by one-half, that is to say, the better deposits, which in a still solution require from 3 to 4 hours, by the use of an agitator, may be plated equally well in from 1½ to 2 hours. It follows, therefore, that a plant equipped with this system is able to produce as much work in a given time as one of twice the size on the ordinary still solution system. Circulating the electrolyte brings a continuous supply of solution of full metallic strength in contact with the electrode. There is less resistance to the current which may be used in greater quantities without danger of burning or oxidizing. A given amount of work plated in a still solution and employing 35 amperes at a tension of 2 volts, giving 70 watts and time of deposit 3 hours, by the use of an agitator, may be plated in the same tank and the same solution with a current of 65 amperes at a tension of 3 volts, giving a current density of 185 watts, the time of deposit will be reduced to 1¼ hours and the resulting deposit will be smoother and brighter.

Suggestions For the Plater

Regardless of the method employed, attend to the following and very little trouble will be experienced:

Keep the solution clean and the metallic strength normal.

Never make chemical additions when the bath is working well.

When additions are necessary, dissolve the chemicals in a portion of the solution.

Never add solids.

Keep the temperature of room at 60 degrees Fahr. in the winter and remember a heavy article, or a number of pieces, requires a thicker wire to conduct the current from the rod than a small one.

If not conversant with the ills attending the free use of liquid ammonia, leave it alone, it is dangerous in unskillful hands.

Flaky deposits result from alkalinity.

See that the scourer or cleaner observes cleanly habits while engaged in the preparation of the work.

Blowing of Malleable Castings

By Richard Moldenke

THE PROBLEM of the cause of cast metal blowing at the junction of steel inserts, whether for malleable or gray iron purposes, presents many interesting features to the foundryman. However, it resolves itself into a knowledge of conditions underlying this phenomenon and then taking the necessary precautions to prevent its occurrence.

The insertion of comparatively light iron or steel sections, portions of which are to remain embedded in the solidified metal, is a different problem than placing comparatively heavy chill pieces at points where it is necessary to insure sound metal, although in both instances molten iron is in contact with an impervious and cold material. In the case of chills, however, these often are so heavy in section, compared with the metal to be cooled, that there is a rapid reduction in temperature and the metal sets quickly at the point where it is to be chilled. Therefore, any gases that may be evolved by the iron would work out through the liquid metal behind that which is setting. It is only necessary to so protect the surface of the chill that during the washing of the metal against it before setting, it will not alloy with the chill and thus result in the latter burning on. A coating of thick oil which will carbonize sufficiently, or which at least will hold the two metal surfaces apart until the iron poured is set, is all that is necessary. The foregoing refers particularly to fairly thick chills which are set against castings of similar section and on which the rust that might accumulate on the chill does not have a chance to play its part.

Inserts in Castings

In the case of comparatively thin inserts involving the alloying of the metals at the junction, different conditions exist. In this case, the washing of the metal continues for some time, comparatively speaking, until the mold is filled. The thin insert has time to acquire a red heat, thus making chemical reaction possible. If the surface of the insert is absolutely clean and also free from moisture, there is no possibility of gas form-

ation. If the insert, on the other hand, is rusty, either when placed in the mold or as a result of the moisture from the damp sand in the mold, the indications are favorable to the formation of gas as a result of the reaction between the oxygen of the iron rust, which is an oxide of iron, and the carbon of the molten iron, which surrounds it and is still liquid. A minute amount of rust will evolve considerable gas and will result in a blow.

Foundrymen generally are familiar with the unsatisfactory results obtained by the use of rusty inserts and when chaplets are used, care should be exercised to have them absolutely clean, or preferably they should be tinned. The molten iron coming in contact with the tin volatilizes this metal, leaving a clean iron surface for the metal poured to adhere to without blowing. However, it is not generally known that the black scale always found on steel plates or rods used as inserts also is an oxide of iron, namely, magnetic oxide. When heated to redness by the surrounding molten iron, this oxide results in the evolution of gas and a blow occurs. Manufacturers of chilled rolls experience this difficulty from the use of fire-cracked chills. These cracks acquire this black scale and when the immediate surface of the chill is raised to a red heat and there is still molten iron against it, a gas bubble forms, usually resulting in the condemnation of the roll. For this reason hotter metal can be cast against new chills than against chills that have been used for a considerable time.

Scale on Steel Inserts

Unless this black scale has been removed from steel inserts, particularly on the surface where it is intended to have the molten iron contact with it, trouble will be experienced. In fact, coating the insert will not solve the difficulty. Unless the coating is volatilized immediately, the carbon formed on the insert will cause a blow. Regardless of the coating used, it is employed only for the purpose of preventing the formation of rust on the cleaned iron surface, as a result of coming in contact with the damp sand of the mold. A coating for iron or steel inserts should volatilize almost instantly upon contact with the molten metal, whereas for chills it is not absolutely necessary for it to do so.

If light chills are used against heavy sections, any scale on the surface will result in the same reaction as that caused by scaled insert steel and for this reason it is necessary to use a coating which not only prevents burning-on, but which, in a measure, will prevent the chilled surface from getting too hot. A good coating may consist of kerosene, to which graphite is added, and this may be applied similar to paint.

If the steel inserts for malleable or other castings were cleaned carefully by sand blast and then tinned, trouble from blowing would be avoided entirely. It may be necessary to perforate, cut or bend the tinned inserts or chaplets and as any one of these operations destroys the tinned surface, oxide of iron will form at these points. For this reason, the chaplet or insert should be tinned after it has been formed into its final shape.

A Better Melting Ratio

By W. J. Keep

Question:—Our cupola is lined to 72 inches, and on heats aggregating from 54,000 to 62,000 pounds our melting ratio varies from 8 to 8.60 to 1. The bed contains 2,880 pounds of coke and the first charge consists of 7,600 pounds of iron. The subsequent charges consist of 360 pounds of coke and 3,900 pounds of iron. The height from the cupola bottom to the lower edge of the tuyeres is 14 inches and the blast pressure varies from 11 to 13 ounces. We melt 60,000 pounds of iron in about 2 hours and 20 minutes. Our iron is sufficiently hot and is used for light scale work, and whatever heavy work we have. What I would like to know is whether our melting ratio is satisfactory and if it would be possible to cut the bed in half and to obtain hot iron. Recently I learned that one firm is charging 1,250 pounds of coke on the bed and subsequent charges consist of 220 pounds of coke to 3,000 pounds of iron. The last six charges consist of 200 pounds of coke and 3,000 pounds of iron, respectively. The total melt is 96,000 pounds and the melting ratio is about 12 to 1. I am wondering whether it is possible to obtain as good results as indicated by these figures.

Answer:—No doubt you could obtain as good results, provided your iron was sufficiently hot for your work. The scrap should be broken as small as the pig iron and care should be exercised not to throw any dirt into the cupola. In zero weather you cannot do as well as in warm weather. In the foundry to which you refer, the cupola employed probably is not as large as the one which you operate. If your furnace is equipped with two rows of tuyeres, close the upper row with brick. Next, take an iron rod, ⅛ inch in diameter and bend about 2 feet of this rod at one end at right angles. Pass the rod through the charging door before you close the bottom doors and let the bent end rest on the door sill. Bend the lower part of the rod at right angles toward the center of the cupola so that it will extend about 15 inches above the tuyeres and this distance above the upper row, if there are two rows of tuyeres. Take out the rod before making the cupola bed. Arrange your blower to provide at least 14 ounces of blast, but 16 ounces is better. Start your fire 2 hours or 2½ hours before the iron is required. Just before you begin to charge the iron, insert the rod in the cupola and if it bears on the charging door sill, you must add coke until the lower end rests on the surface of the coke bed. On the other hand, if the upper end extends above the charging door sill, you should add less coke the next day, so that the rod will simultaneously touch the bed and charging door sill. This practice is largely one of measuring, but if you will weigh your coke, you will soon ascertain what amount will be required to bring the top of the bed to the right height. Your bed probably will weigh 2,500 pounds and if there is any difficulty in obtaining hot iron from the first charge, it should be reduced until hot iron is obtained. In reducing the coke charges, this should be done at the rate of 10 pounds per charge per day.

The coke on the last charge can be reduced considerably and it is probable that you can melt the last charge without coke. A ratio of 9 to 1 is considered good melting for stove plate and 10 to 1 is better than usual for machinery work. If your melting ratio is better than this, great care must be exercised in the operation of your cupola, as a poor grade of coke or careless charging will result in dull iron throughout the heat and the loss will be much greater than the economies effected in the fuel consumption. Care also should be exercised to charge the cupola uniformly, and you should use 20 to 40 pounds of limestone per ton of metal. The slag should be tapped after the fifth charge.

About 150 foundrymen from Chicago and vicinity attended the turkey dinner given by the Chicago Foundrymen's club at the Auditorium hotel, Saturday evening, Feb. 8. There was no formal program, the entire evening having been devoted exclusively to entertainment features. This was the first of a series of get-together meetings planned by the Chicago foundrymen in preparation for the fall convention.

Fire Clay for Foundry Use

By E. H. Oehler

Fire clay is a highly refractory, earthy material, plastic when wet and capable of being molded into almost any desired shape. It is composed of particles of various minerals in different stages of decay, there being present oxides, carbonates, hydroxides, silicates, etc. The number of different minerals occurring may be quite large, but for general purposes clay may be considered as a combination of quartz, feldspar and kaolinite, or some similar hydrous aluminum silicate. The latter is denoted clay substance, or clay base, and very largely contributes plasticity.

The ordinary chemical or ultimate analysis is one of the first essentials in selecting fire clay. A good fire clay for foundry use should approximate the following analysis:

	Per cent.
SiO_2	55.00
Al_2O_3	29.00
Fe_2O_3	1.50
CaO	0.50
MgO	0.40
TiO_2	1.60
Alkalies	1.50
Loss on ignition	10.50

Any very great increase in any of these constituents will cause a lowering in the melting point of the clay. Steel is cast at a temperature of about 2,900 degrees Fahr. and in order to withstand this heat, the fire clay should not fuse below 3,200 degrees Fahr.

Rational Analysis of Clay

The rational analysis of clay is also very valuable in judging its properties. This analysis is not undertaken as a rule, but its use should be more general. The following method gives very good results and properly finds a place here. The object of the rational analysis is to determine, in a general way, the constitution of the clay. It shows the ratio of quartz, feldspar and clay substance (kaolinite) existing in the sample.

Two grains of clay are digested with 20 cc of concentrated sulphuric acid on a hot plate. The solution is cooled, diluted with water, filtered and washed with hot water. The residue on the filter is washed into a 50 cc beaker with about 15 cc of 10 per cent sodium hydroxide solution and digested two or three hours with heat, then diluted with about 35 cc of water, filtered and washed. What remains on the filter is washed back into the beaker with about 25 cc of hydrochloric acid (Sp. Gr. 1.1) and again digested, filtered and washed. This last residue is ignited and the loss represents kaolinite or clay substance. The resents kaolinite or clay substance. The successive treatments with acid and alkali have dissolved out the clay substance, leaving feldspar and quartz.

The residue, consisting of quartz and feldspar, is fused with sodium carbonate and the silica and alumina determined. Multiplying the percentage of alumina by 5.41 gives approximately the amount of feldspar present and the quartz is found by difference.

Another method of arriving at the same result is to multiply the alumina in the residue by 3.51, which gives the amount of silica found in orthoclase feldspar. This silica subtracted from the total silica in the insoluble residue gives the percentage of quartz. The sum of the alumina, ferric oxide, alkalies and 3.51 times the alumina, represents feldspar. Neither of these calculations gives absolutely correct results, but for the purpose of comparison the values are very interesting.

Calculating the Clay Base

A simple method of calculating the clay base from the ultimate analysis is to consider all the alumina to be contained in the kaolinite, multiply it by 1,169 to find the amount of silica required and add this product to the aluminum and combined water. Out of numerous samples, those running about 72 per cent kaolinite, 6 per cent feldspar, 22 per cent quartz, show up very well in actual service.

Feldspar acts as a fluxing agent and materially lowers the melting point. Kaolinite or clay base is composed of silica 46.4 per cent, alumina 39.7 per cent, water 13.9 per cent, and melts at 3,300 degrees Fahr. If kaolin is mixed with pure white sand in increasing proportions, it is found that the melting point of the resultant mixture is lowered until the proportion, kaolin, 10 per cent, and sand, 90 per cent, is reached. With this mixture the melting point is about 3,000 degrees Fahr. Any further addition of sand raises the melting point. In this way it is seen that a high percentage of quartz quite appreciably lowers the melting point.

Influence of Bases on Refractory

The refractory properties of any clay are most influenced by the bases in the following order: Iron oxide, magnesia, lime, soda, potassa, titanium oxide, and silica. The influence of the first five is most important, as comparatively small quantities affect the fusibility to a great extent. The fact that silica acts as a flux is interesting to foundrymen because it is the usual practice to add clay in mixing facing sand. The several characteristics of a good foundry clay are as follows:

It must have a low percentage of fluxing impurities, or in other words, the percentage of iron, lime, magnesia and alkalies must be low, about 3.50 per cent. The silica should run pretty close to 50 per cent, as any great increase over this lowers the melting point and also affects the plasticity.

It must have as much bonding power as possible and this is largely due to the amount of clay substance or kaolinite present. The basis principle of good molding is to keep the proportion of clay down and the larger the percentage of clay substance, the less clay is required.

It should be finely ground, as the plasticity varies to a great extent with the size of the grain. The finer clay mixes more intimately with the sand. In this connection, it is well to note that facing sand should be well milled. Many scabby, dirty castings are the direct result of too much haste in mixing the sand and in no way is caused by poor materials. It is very easy to test the fineness of the various clays by running them through sieves of several different degrees of mesh.

Fire Clay for Foundry Use

It is almost needless to state that fire clay for foundry use need not be of the highest grade obtainable. No. 1 fire clays, such as are used for glass pots, which, undoubtedly, require the most refractory, are too expensive for foundry use and as a matter of fact would not justify the added expense. The lower grade clays, melting around 3,200 degrees Fahr. or 3,300 degrees Fahr. if properly used, will give just as good results. It sometimes happens that two clays of approximately the same chemical analysis show up very different in practice. One may give perfect satisfaction while the other is the cause of much trouble. Very often the rational analysis will show wherein they differ and for this reason its use should be more general. If it should fail, the only satisfactory test is to ascertain the actual melting points, which is usually a matter of great difficulty for the foundry chemist. The best method is to find a satisfactory brand and to stick to it.

The Newark, N. J., office of the H. W. Johns-Manville Co. has been removed to 239 Halsey street. The floor area of the office and sales room aggregates 4,000 square feet, which affords ample display space for the varied line of products manufactured by this company.

Large Water Wheels for Keokuk Power Plant

A Discussion of the Problems Involved in Molding, Casting and Transporting These Large Gray Iron Runners

AT KEOKUK, IA., the Mississippi river has been harnessed by the Mississippi River Power Co. for the purpose of converting the water power at this point into electric current for the use of the manufacturing industries in this valley, as far distant as St. Louis, which already has contracted for 60,000-horsepower. This project is one of the largest that has been undertaken in this country and ranks high with the foremost plants of its kind in the world. The power developed at the generators will be over 231,500 kilowatts and the capacity of the turbines will be 310,408 horsepower, while the power offered for sale will aggregate 200,000-horsepower. The company has its headquarters in Boston, where its president, Edwin S. Webster, is located, and the chief engineer is Hugh L. Cooper. The plant consists of a dam, power house, lock, dry dock, sea wall and ice fender, constituting one concrete monolith with a total linear measurement of 13,185 feet, or approximately 2½ miles. The turbines which will drive the generators are of the Francis type, but of special design, with a capacity of 10,000-horsepower each, and an overload capacity of 13,500 horsepower. They have an efficiency of 86 per cent by Holyoke tests and will operate at the slow speed of 57.7 revolutions per minute. The single thrust bearing set above the water will carry rotating parts weighing 550,000 pounds. Each turbine is direct-connected with a generator on a vertical shaft, 25 inches in diameter. The rating is based on a head of 32 feet.

The contract for seven of the 15, 10,000 - horsepower hydraulic turbine units for this plant was awarded to the Wellman - Seaver- Morgan Co., Cleveland, and this equipment now is being built at this company's Cleveland and Akron, O., plants. Each turbine is equipped with a vertical runner, which is the largest wheel of its type ever cast in one piece. Another company which was awarded a part of this contract is casting these runners in seven pieces as the railroads serving this plant are unable to handle them intact, owing to the numerous tunnels on their lines. A finished wheel in the machine shop of the Wellman-Seaver-Morgan Co., at Akron, is illustrated in Fig. 1, the curved vanes showing the bottom section. The castings are gray iron, and thus far three have been successfully cast without loss. The prin-

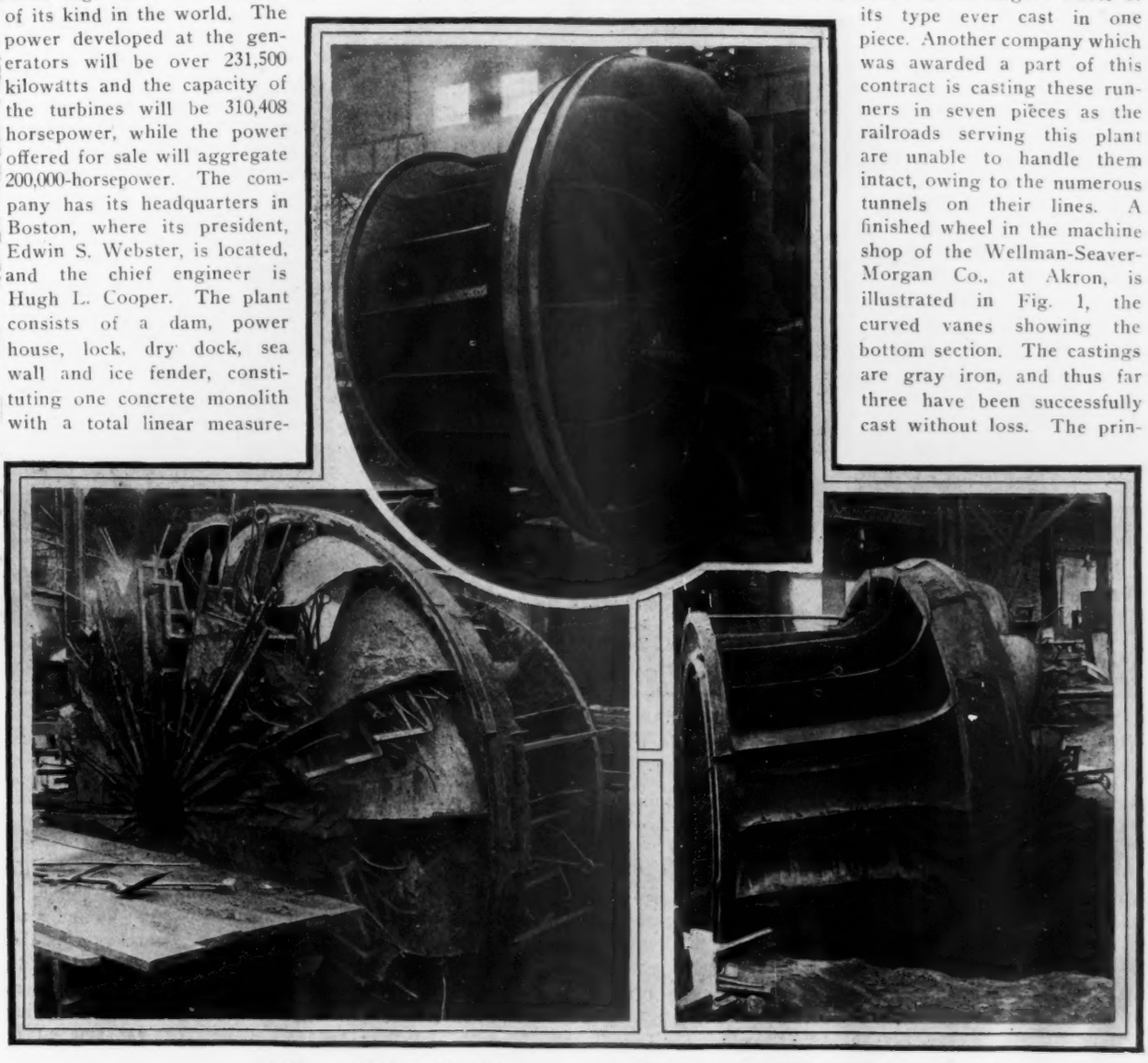


FIG. 1—ONE OF THE FINISHED WHEELS IN THE MACHINE SHOP

FIG. 2—CLEANING ONE OF THE WHEELS IN THE FOUNDRY

FIG. 3—ANOTHER VIEW OF THE CASTING BEFORE ITS REMOVAL FROM THE PIT

cipal dimensions of the runner follow: Outside diameter at the large or bottom end, 16 feet 6 inches; outside diameter at the small end, 12 feet 8 inches; length, 11 feet 2½ inches; weight, rough, 136,000 pounds, and finished, 128,000 pounds. Each runner has 16 vanes and is equipped with a hollow nickel steel shaft, 21 feet 1¾ inches long; 25 inches outside diameter, and 8 inches inside. The weight of each shaft is 36,000 pounds, and the hydraulic turbine unit complete weighs about 1,000,000 pounds. The

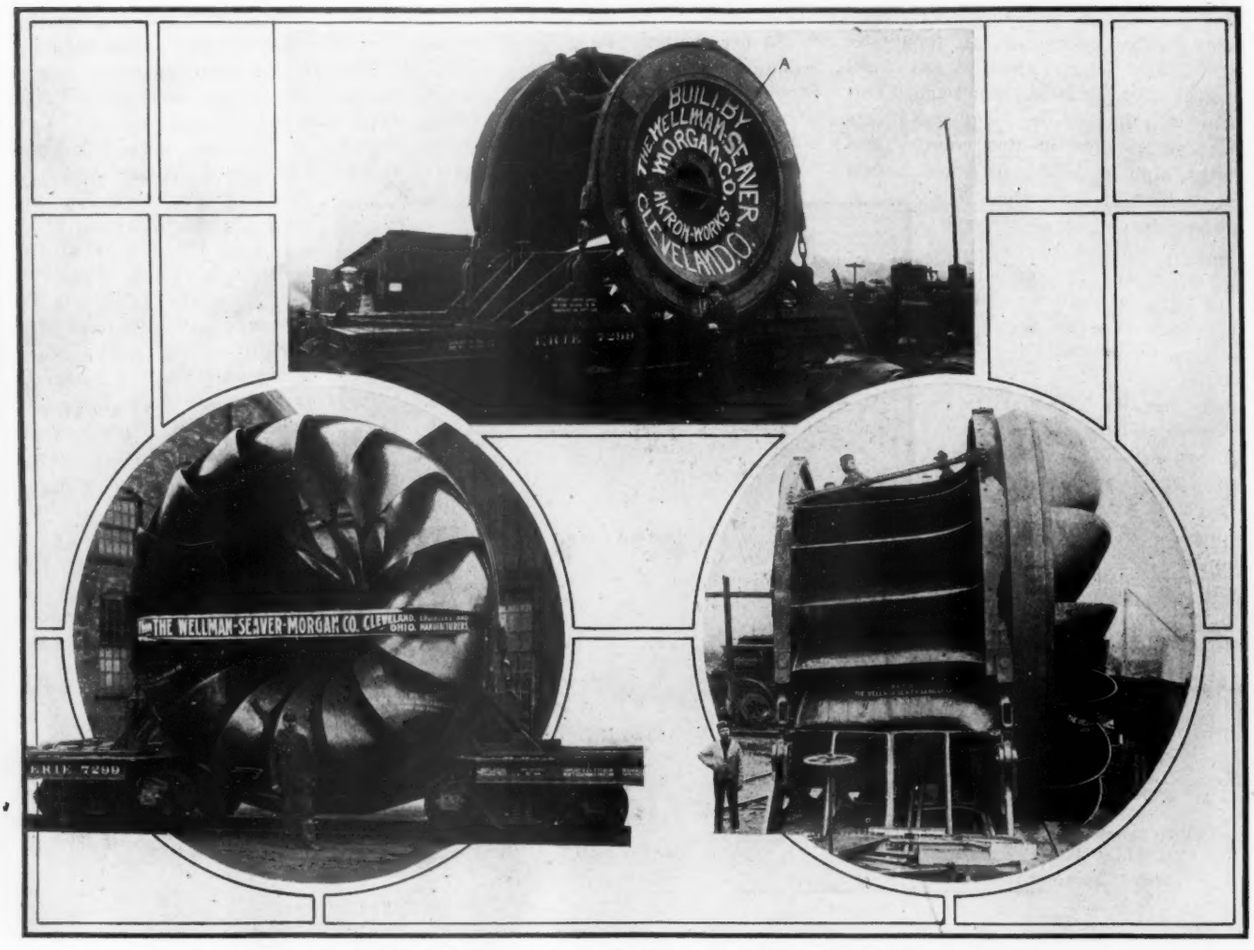


FIG. 4—SIDE VIEW OF THE CAR, SHOWING THE SMALL END OF THE WHEEL

FIG. 5—OPPOSITE SIDE OF CAR, SHOWING LARGE END OF WHEEL

FIG. 6—END VIEW OF CAR ON WHICH THE CASTING WAS SHIPPED

molds are made in a pit, 11 feet deep and 26 feet in diameter, and extend about 9 feet above the floor. Owing to the immense amount of labor involved in making the molds and cores, assembling, finishing and cooling, the castings are being made at the rate of one every 1½ months. The mold is cored throughout and each of the 16 dry sand cores for the vanes weighs 8 tons. Practically the entire mold is in the drag, the cope consisting merely of a cover. The bottom plate in the pit, on which the mold is made, is machined on both surfaces and is 5 inches thick and 20 feet in diameter. The foundation for the plate is concrete, 16 inches thick.

Binding the mold to prevent the lifting of the cores presented quite a problem, as the surface area of the vanes is approximately 18,600 square feet. This was accomplished successfully, however, by employing 16, 20-inch steel I-beams, which were laid across the top of the mold and were attached to the bottom plate by 32, 3-inch rods, provided with turnbuckles for clamping the mold. The turnbuckles are located slightly below the floor level to avoid interference with operations on the floor when casting. To insure an ample outlet for the gases, 64 vents were provided and the runner trough for the metal extended across the top of the mold and was built between two of the beams, which served to bind the mold. From the runner the iron entered the mold through 12 gates.

As nearly 70 tons of metal were required to pour the mold, one 30-ton receiving ladle, and two ladles of 30 and 20 tons capacity, respectively, were employed. The iron was melted in three cupolas, 60, 76 and 84 inches inside diameter, and the heats were regulated to bring down the iron at practically the same time. The pouring operation consumed about 4 minutes and each wheel was left in the sand about 12 days. The removal of the casting from the pit presented another difficult problem, as the metal, cores and sand weighed approximately 200 tons. As the sides of the flask were cylindrical, rolled steel sections, these were removed first and permitted a large percentage of the rammed sand to fall away from the casting. Whatever cores could be removed were then dug out and after the casting was lightened in this way, it was turned over on its side, as shown in Figs. 2 and 3. This was accomplished by two 30-ton traveling cranes with their chains attached to an equalizer beam, from which the hook was suspended that was attached to the casting. After removing

the cores and cleaning one-half of the casting, it was again turned over and the cleaning operation was completed.

To machine the wheels, both top and bottom, an unusually large boring mill had to be employed, and as the equipment of the machine shop was inadequate for this work a new boring mill had to be installed. This machine was designed by the Wellman-Seaver-Morgan Co., and was built complete in its own shops. The mill is one of the largest in the country and has a maximum capacity for handling work 31 feet in diameter and 12 feet high. The table of the mill is 18 feet in diameter and weighs 80,000 pounds. The mill is equipped with three traveling heads. The table is driven by a 30-horsepower motor, and a 15-horsepower motor furnishes power for raising and lowering the rail. For operating the drawback on the housings a 10-horsepower motor is provided. The mill can travel on its housings a distance of about 8 feet 7 inches. This travel gives the machine its maximum capacity for machining work up to 31 feet in diameter, while its rated capacity is 18 to 31 feet. The concrete foundation for the mill is 23 feet wide, 32 feet long, and 12 feet 2½ inches deep. The weight of the boring mill is 440,000 pounds.

Transporting the Castings

The transportation of the wheels to the power plant at Keokuk, Ia., was the next problem. Owing to their size and weight, a special car had to be built, which is shown in Figs. 4, 5 and 6. The contract for transporting all of the parts of the seven turbine units, aggregating 130 carloads, was awarded to the Erie railroad, and the special car of 75 tons capacity for these wheels was built at the Erie shops, Kent, O. As the castings are 11 feet 2½ inches long, and 16 feet 6 inches in diameter at their large end, they were loaded on their side on the car in such a way that their widest part would clear 3 feet above the rail. As a result of this method of loading, the height of the casting from the top of the rail was 17 feet 6 inches.

To throw the entire load onto the trucks, two cast steel saddles were designed and made by the Wellman-Seaver-Morgan Co., on which the entire weight of the casting is carried. These saddles are shown clearly in Figs. 4 and 5. The car also is reinforced by a box type girder, 20 inches wide, strengthened with angles and an extra plate on its bottom side. To prevent the wheel from shifting, two bands were fastened around its circumference on either side, as illustrated in Fig. 4. These bands passed over the machined surfaces of the casting and were held with pieces riveted to their inner sides as a further precaution against shifting. In addition, the bands were prevented from moving laterally by braces bolted to their sides, as shown in Fig. 6. The bands were tightened by turnbuckles, the lower screws having eyes, which were mounted on pins in the saddles.

The first casting was shipped to Keokuk, on Nov. 8, last year, by way of the Erie, Elgin, Joliet & Eastern, Chicago, Burlington & Quincy, and Toledo, Peoria & Western railroads, this circuitous route being necessary to avoid tunnels through which the casting could not pass. One of the interesting features of the three wheels made is the small amount of counterbalancing required. The first wheel made was counterbalanced 1,075 pounds, as shown at *A*, Fig. 4, whereas the third wheel was counterbalanced only 92 pounds.

The Electric Brass Furnace

In the January, 1913, issue of THE FOUNDRY, page 27, is published a short article by C. Vickers, entitled "The Electric Brass Furnace", in which some statements are made with which I cannot entirely agree. The general trend of the article is to the effect that the melting of brass in an eectric furnace does not possess some of the advantages claimed for it, although in conclusion Mr. Vickers states that "the problem, of course, will be solved", etc. It is not to be denied that unreasonable, exaggerated, and in some cases, false claims have been made by enthusiasts or sellers of electric furnaces, which, in the opinion of the writer, have considerably harmed the cause. On the other hand, it seems to me that some of the statements made by Mr. Vickers also are exaggerated and that some of the objections he points out can be and have been overcome.

It is true that the unmelted metal in the furnace is subjected to the oxidizing influence of the air over the top of the charge, but in electric furnaces of the resistance type, as distinguished from the arc type, the top of the furnace may be sealed almost hermetically. The space over the charge can be reduced to the minimum and, therefore, the only oxidizing influence is that of the air originally in the furnace. A small amount of charcoal or, in some cases, wood will readily consume the small amount of oxygen present, making the atmosphere neutral, and it would even have a tendency to make it reducing. In a fuel furnace, in which the hot gases continually pass over the unmelted metal or the metal bath, there is a continued renewal of the oxidizing atmosphere even under the best possible conditions, thereby promoting oxidation.

The Fuel Question

Mr. Vickers states further: "The fact that no fuel is used (in electric furnaces) makes no difference, as the oxygen and nitrogen of the atmosphere come in contact with the metal to the same extent as in a fuel-fired furnace and in some types of electric furnaces, to a much greater extent than is possible in a fuel furnace." I do not agree with the latter assertion. His further statement that "the resulting metal is inferior to that melted in a fuel-burning furnace", therefore, is not warranted when applied to electric furnaces in general. On the contrary, when the melting takes place in a strongly reducing atmosphere, such as readily can be obtained in an electric furnace, not only should oxidation be eliminated, but there may be an actual reduction of some of the oxides already present.

I do not agree with his prophecy that the successful electric furnace for melting non-ferrous metals and alloys undoubtedly will be of a type that melts by arc radiation. On the contrary, I am of the opinion that the successful furnace will be of a type that does not employ the arc, but generates the heat directly in the molten metal itself. The writer has developed an electric furnace of this type, which melts not only non-ferrous metals, but also ferrous metals in this way. The arc radiating furnace produces a temperature much higher than is necessary for melting brass and for this reason the heat losses will be much greater than they should be. Moreover, it has been found difficult and expensive to maintain the roofs of arc radiation furnaces, which are subjected to the high temperature of melting mediums of this type. The temperature that can be obtained is approximately 3,000 degrees Cent., or 5,500 degrees Fahr. Losses due to the volatilization of the zinc at this high temperature would be excessive, as the space over the metal, of necessity, would have to be quite large, relatively, and on account of the moving electrodes, the roof of the furnace could not be made gas-tight. Therefore, the atmosphere inside the furnace would be continually changing, thereby increasing the losses due to the vaporization

of the zinc. Attempts are made to prevent this by covering the bath with a coating of slag, but as Mr. Vickers correctly states, the cold metal floats on the slag and is not covered by it until after it is melted. Therefore, until melting occurs, there will be excessive losses of zinc. Furthermore, a furnace in which the heat must pass downwardly through a layer of slag necessarily involves generating much higher temperatures than those necessary for melting the metal and for this reason the heat losses are greater.

Non-Oxidizing Atmosphere

When the heat is generated in the molten metal itself, which is the case in some resistance types of furnaces, no such excessive temperatures are involved and the atmosphere surrounding the unmelted metal not only may be made non-oxidizing, but even reducing by the addition of a small amount of charcoal or wood.

An electric furnace of the type referred to possesses many advantages which outweigh the only real objection to the electric furnace, namely, the higher cost of the original source of heat. The heat efficiency of a well-designed electric furnace is so much greater than the heat efficiency of a fuel furnace that the actual difference in cost per pound of metal is not very great and in fact may favor the electric furnace. In addition, the electric furnace eliminates oxidation, reduces the loss of zinc by vaporization, prevents the contamination of the metal by the sulphur from the gases and permits the maintenance of a uniform temperature. The particular type of furnace which the writer has developed has a cleansing or refining action on the metal, due to the systematic upward circulation which carries impurities to the top where they can be caught by the slag and eliminated. It is evident, therefore, that these many advantages will outweigh the higher cost of the original source of heat.

CARL HERING.

Philadelphia.

Copper for Automobiles

Although it is recognized that the development of the automobile industry has called for increasing amounts of copper, the extent of the consumption of this red metal on this account is not generally appreciated. Detroit is doubtless the leading city in the manufacture of motor cars, and no small amount of copper is shipped direct from the upper peninsula of Michigan to the City of the Straits. J. J. Hayes, manager of Gay & Sturgis, Detroit, furnishes some interesting data showing the amount of copper in each car of several well-known makers. He says: "There are 47 pounds of copper in every small Ford car; 100 pounds in every Cadillac, and 90 pounds in every Packard, to say nothing of all the other cars manufactured in Detroit. This year the Ford output will be 200,000 cars. That means a total of over 9,000,000 pounds of copper used by this single automobile manufacturing plant. Nine million pounds of copper is the total yearly output of some of our mines. It is half the yearly output of the Osceola Consolidated mine alone, and the Ford is only one of 40 automobile manufacturing companies that use an average of better than 50 pounds to every car that is built. This automobile data alone will tend to show where all the additional copper has gone, and where a lot more of it is going in the future."

Pure Silicon Castings

While it has been known that pure silicon possesses remarkable acid-resisting properties; nevertheless, no use was ever made of this metal because it was not available in commercial quantities and no method was discovered for making these castings. The Carborundum Co., Niagara Falls, N. Y., has succeeded in producing silicon metal in large quantities and has reduced the cost of manufacture to such an extent that this metal is given a place among the baser metals and has been taken out of the class of laboratory curiosities. To reduce the silicon from the silica sand, large electric furnaces are employed in which a mixture of coke and pure silica sand is charged. At the high temperature attainable in these furnaces, the reduction of the silica occurs and silicon metal is produced, varying in purity from 90 to 98 per cent. The principal impurities consist of iron and aluminum.

The development of a successful method of casting silicon has been the subject of extended investigation and was effected with great difficulties. The Carborundum Co. recently has succeeded in developing processes for making silicon castings of all ordinary shapes and sizes.

Properties of Cast Silicon

The physical properties of cast silicon follow: Density, 2.5 to 2.6; melting point, 1,430 degrees Cent.; boiling point, 2,800 degrees Cent. (calculated); hardness, 6 on Mohs scale. Its tensile strength is approximately 1,000 pounds per square inch and it is the least compressible of any metal. Sulphuric acid, in any concentration under gentle evaporation has no action on silicon. Nitric acid, either dilute or concentrated, has little effect on this metal. Hydrochloric acid has a slight, but continuous solvent action on silicon, while hydrofluoric acid attacks it vigorously. In practice, silicon metal appears to be highly resistant to chlorine and chlorine liquors, and phosphoric acid shows a continuous, but slight attack, which does not altogether disappear. This results in a slight turbidity in the product treated. However, all alkalies will attack silicon readily.

Silicon is used in the form of pipes for the conveyance of acid gases at high temperatures from stills to condensers, also in the construction of the condensing batteries themselves and proves much more efficient than stoneware. Silicon pipes also are used for the transportation of hot, liquid sulphuric and nitric acids. For lining purposes, this metal is used in centrifugal pumps, acid valves and pipes for the elevation of corrosive liquids by compressed air. Castings are preferably made at least ½ inch in thickness with the exception of pipes less than 2 inches in diameter, which can be made with a ⅜ or ¼-inch wall. Sharp corners and sharp bends must be avoided in designing apparatus to be cast in silicon. Owing to its low specific gravity, silicon is replacing gray iron for acid work, as a silicon casting is approximately only one-third the weight of an iron casting of the same form.

Metal Statistics

The 1913 edition of *Metal Statistics*, issued by the American Metal Market Co., New York City, contains 255 pages, principally devoted to a record of the average prices of pig iron, finished steel, metals, etc. in 1912. In addition, tables are included showing the production of various metals in the United States. This issue, which is the sixth edition, contains a rearrangement of a number of the old tables with a view of presenting these statistics in the most convenient and comprehensive form and a number of new tables also have been added.

The Goldschmidt Thermit Co., 90 West street, New York City, is sending a calendar to the trade, which, in addition to the date pad, contains illustrations of various thermit-welding operations.

Utilizing the Waste Heat from Brass Furnaces

Various Types Designed to Facilitate Melting Are Described, With Details of Their Construction

By Joseph Horner

UNTIL recently the brass furnace has been a greatly neglected piece of foundry equipment. Although many attempts have been made to economize fuel, relatively little encouragement has been meted out to proposals of that kind. In many foundries the old furnaces are still retained, though much better melting mediums might be installed. Unfortunately, uniformity in data is not available, even in the degree to which it can be had in

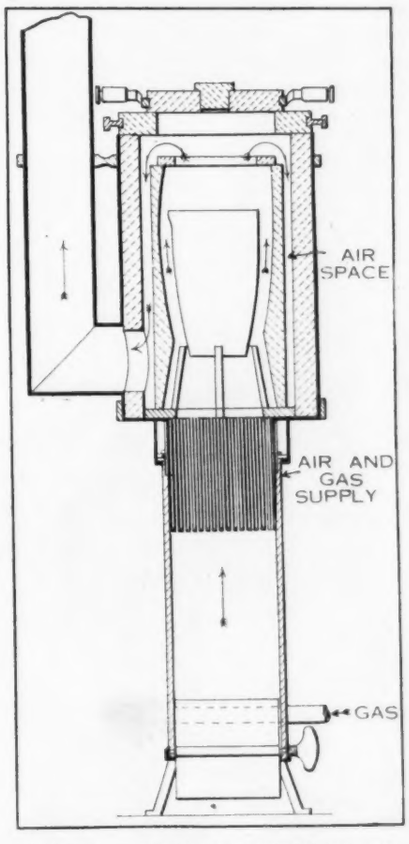


FIG. 1 — FURNACE DESIGNED BY GEORGE GORE

cupola practice. The work is very irregular. Often a large quantity of coke is used for melting copper and tin, or scrap for ingoting, a distinct change from the practice pursued in melting alloys for casting purposes. Unburnt coke is wasted when the fire is dropped and the draft and intensity of melting vary. For this reason, probably, one and one-half of the metal to one of coke may be taken as a fair average for legitimate melting for casting purposes.

As in cupola practice, so in the brass foundry, the quality of the metal, free from contamination, and its temperature for pouring are as essential as a high melting ratio. In the light of this average the results of melting in some of the furnaces utilizing waste heat show to great advantage. One element in many of these is that the wastage of metal is often lower than it is in the ordinary furnaces where the gases are practically in continual contact with the metal, which is thereby liable to contamination.

Coke Hole Furnace

The commonest type of brass melting furnace is that shown in Fig. 8. In the construction of this furnace no attempt is made to utilize the waste heat, which goes directly into the stack. After the furnace attains a melting temperature, the brickwork retains the heat for a long time and the damper serves to regulate the temperature. Therefore, it is a useful and popular type, being readily built singly or in batteries, and the cost of repairs is low.

Until recent years, this type of rather wasteful furnace was retained in the majority of foundries, both in the United States and England. These, to a large extent, are being replaced rapidly by self-contained oil, gas and coke melting furnaces which utilize their own waste heat and some are so designed that they retain the heat within the furnace, thereby greatly reducing the fuel consumption. In many of these the crucible is retained in the furnace during the whole period of its life, instead of being lifted out for each cast. These furnaces, however, hardly come within the scope of the present article which deals only with the direct employment of the waste heat within the furnace.

Attempts to utilize waste heat in brass foundries dates back a good many years, as also do the efforts made to burn gas instead of solid fuel, and to substitute blast for the natural draft of a chimney. A selection of these designs, shown in the accompanying illustrations, indicate the lines on which earlier efforts were directed.

In 1863, George Gore, of Birmingham, Eng., patented a furnace, Fig. 1, the principle of which is retained in some of the present types. In this furnace, the waste products, as they left the crucible, instead of passing directly into the chimney, were brought down on the outside of the furnace casing, and were then discharged. The crucible was supported

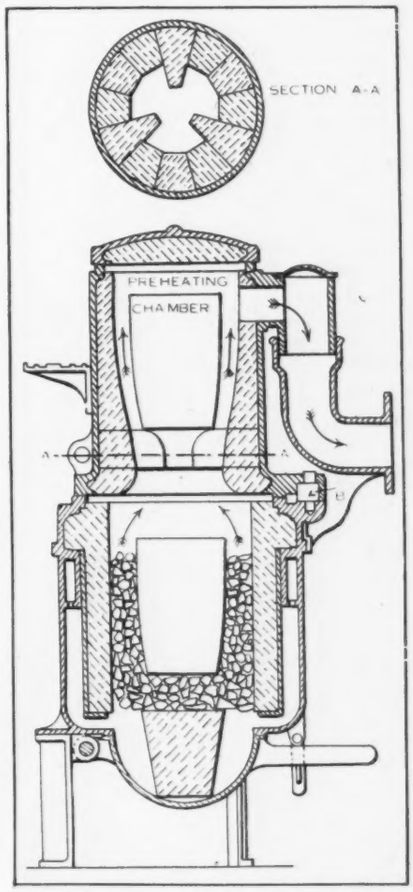


FIG. 2 — FLETCHER FURNACE, EARLY TYPE

and was retained centrally on a block, and was heated with gas brought in below. Air and gas, in suitable proportions, were mixed and ignited with additional air, the air and gas being kept apart by plates of fire clay and metal reaching as far as the bottom of the crucible. The furnace was a tube of fire clay separated from the brick-

lined casing by the annular air space just mentioned.

Another furnace, built on a similar principle, was designed by Johnson, in 1868. It utilized artificial gas, and air. In this type, the waste heat, after leaving the top of the crucible, was brought down through an annular space between the furnace proper and a fire clay cylinder within the casing, thus rendering up its heat on its way to the chimney. The crucible, as shown in Fig. 3, rested on a clay cylinder, or stand, the height of which was regulated with a stem and screw. The furnace was of the muffle type, arched at the top to deflect the heat downwardly. A chamber, *A*, was provided to catch any metal which might flow from the pot in the event of the fracture of the crucible. These are features which are embodied in some high-class furnaces of the present day. The gas was delivered to an annular ring which distributed it to vertical pipes discharging within a ring underneath the furnace, with nozzles converging below the crucible. The supply of air was regulated by a handle controlling the amount of opening of holes in collars surrounding the gas supply pipes.

Fletcher Furnace

Some of the early Fletcher types are strikingly similar to modern furnaces, details only varying. We have

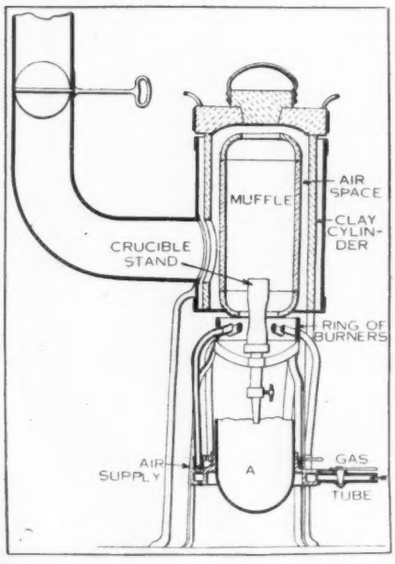


FIG. 3—JOHNSON WASTE HEAT FURNACE

examples of annular surrounding spaces, of preheating chambers, and of drop bottoms. During his busy life, Mr. Fletcher occupied an unrivaled position in his knowledge of gas heating, and built up the immense business which still retains his name. Some of the early furnaces were gas-heated, while others used coke. High melting ratios were obtained.

In one design, Fig. 5, an annular air space between the furnace and the shell received the air from an annular belt above, which, when

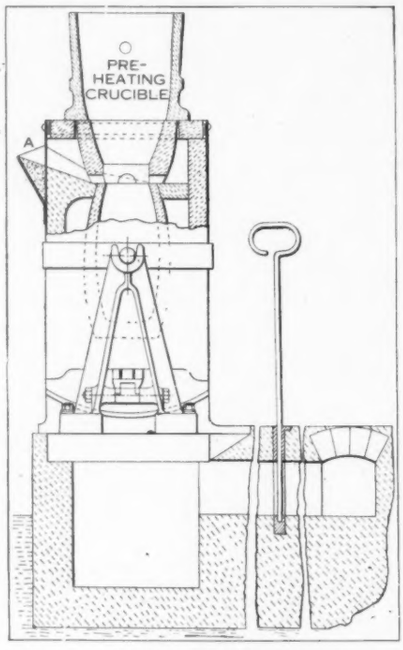


FIG. 4 — PIAT FURNACE WITH PREHEATER

warmed in its passage down the annular air space, entered the furnace at the bottom. In all furnaces of this type the blast is warmed by heat which would otherwise be wasted by radiation through the shell of the furnace. In this design, also, a drop bottom was provided, the grate being of solid refractory material.

The preheater or heating chamber, now very common, also appears in the early Fletcher furnace, Fig. 2. The cover and tile, shown in Fig. 5, are replaced by a heating chamber hinged on top of the furnace to swing in a horizontal plane, and through which the waste heat passes on its way to the chimney. It is really another smaller furnace lined with fire brick, and large enough to receive a crucible of metal to be preheated in readiness to take the place of the one in the melting furnace, after the latter is poured. The hinge pin, *B*, Fig. 2, lies in the axis of the jointed elbow pipes, the joint of which, therefore, is not broken by the movement of the chamber.

The Piat Furnace

The preheater of the Piat furnace, Fig. 4, is a supplementary crucible above the melting crucible, but it is pierced with a hole in the bottom. Ingots and pieces of metal are heated in this way by the waste heat from the furnace below. The crucible is not removed from the furnace during its life, the pouring being done by tilting the furnace bodily, when the metal runs out through the fire clay spout, *A*.

In the furnace manufactured by George Green & Co., of Keighley, Eng., the blast is heated in an annular casing, *A*, which surrounds the lower portion of the body of the furnace, and then passes up into the coke at the bottom. The blast is delivered to the belt by a V-shaped pipe through the two trunnions on which the furnace is tilted for pouring. The top of the furnace is designed in the form of a combined charging hole and preheater, and is lifted during the pouring operation to the position indicated by the dotted lines, Fig. 6, being counterbalanced by weights. It is covered with a hood, not shown, to direct the fumes into the chimney and the furnace has a drop bottom.

Some of the furnaces built by the Morgan Crucible Co., London, Eng., include, in addition to an annular air heating belt and the preheater for cold metal, an arrangement for heating the blast in its passage to the belt by the heat that is leaving the preheater in its course to the chimney. This would seem to be the

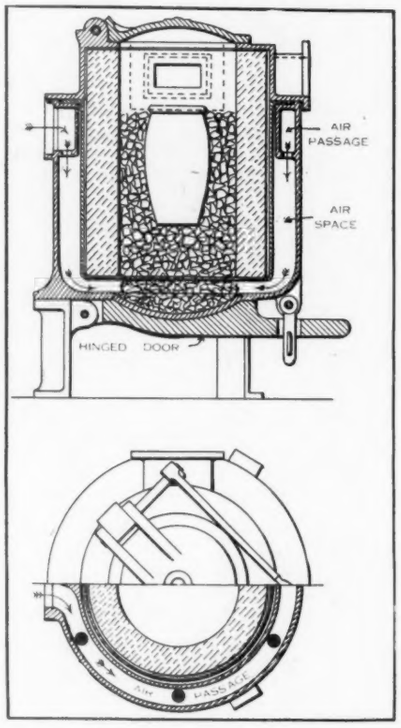


FIG. 5—ANOTHER TYPE OF FLETCHER FURNACE

last stage possible in the economy of the waste heat in a brass melting furnace. A vertical section and plan of this furnace is illustrated in Fig. 7.

The blast, entering through the nozzle, passes down the large blast pipe on its way to the furnace, which it enters through an annular air belt, *A*, and through the fire bars. The belt is formed between the two shells of which the furnace is built. The outer shell is octagonal, the inner one being circular. The latter is lined with fire brick and is pierced with exterior of the discharge flue pipe, and occupying the space between it and the outer blast supply pipe.

We are not concerned in this article with other details of these furnaces, but numerous good features will be noted in the illustration. A lever is provided, by which the preheater section is lifted off its machined joint and swung aside. The Engineering Works, Durlach, Germany. The forced blast entering into the pipe below passes up and through the layer of coke between the lining and the crucible, which forms a combustion chamber; after leaving the crucible the blast passes into the preheater above, partly fusing the metal therein.

The furnace is of the tilting type,

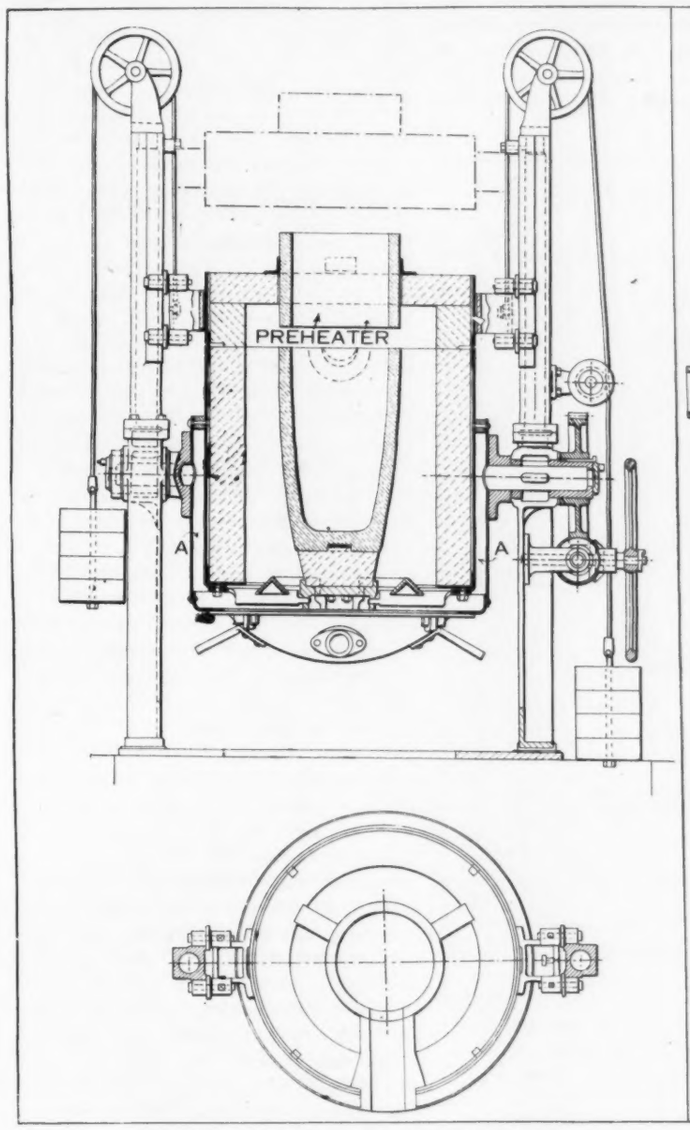


FIG. 6—GREEN'S TILTING FURNACE

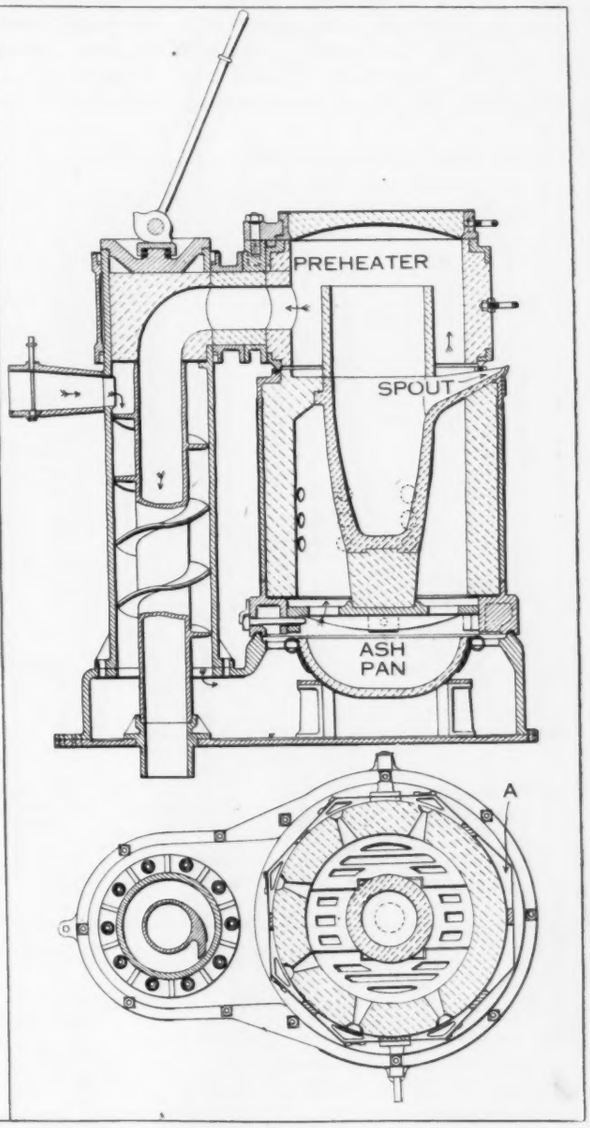


FIG. 7—MORGAN FURNACE WITH PREHEATER

ducts or tuyers, in three tiers. The blast passes from the furnace into the preheater, without impinging upon the metal, and instead of being allowed to pass directly to the chimney it is conducted through a discharge pipe or flue, enclosed within the blast pipe. The object of this arrangement is to delay the movement of the entering blast and to prolong its period of contact with the waste heat escaping to the chimney. The blast has to travel in a spiral path coerced by the spiral cast on the hinged fire bars which are dropped when the day's melting is over, are locked in place by pins. The pan which catches the ashes, and the various tooled joints between the sections of the furnace, are noteworthy features. The furnace also is provided with a counterbalanced tilting gear.

German Furnace

An example of a German furnace which utilizes the waste heat is shown in Fig. 9. It is built by the Baden the crucible never being removed until it is out of service. The metal is poured through the brick-lined spout into a casting ladle carried in arms extending from the sides so that the metal has but a small drop and little time to chill. When the furnace is tilted, the blast pipe joint, *A*, is merely disconnected by the separation of annular tapered faces. If a crucible breaks, the molten metal can escape through two outlets with fusible plugs on each side of the bottom of the furnace chamber.

The metal cannot get into the blast pipe at the bottom of the furnace, since a pocket is provided at the bottom of the pipe to receive it.

Advantages of Forced Draft

The melting of copper alloys in a natural draft furnace requires from one to two hours, depending on the melting point and other circumstances. In a furnace using forced draft the same work is done in from 15 to 45 minutes. In the ordinary natural-draft furnace the charge of coke may equal 50 per cent of the metal melted. 5.63 pounds per pound of coke. The weight melted per hour was 376 pounds. In melting yellow metal the ratios are higher. The company claims roughly, 6 pounds of gun metal to 10 pounds of yellow brass per pound of fuel, an output of 400 to 600 pounds of metal in an hour. Some of these furnaces take crucibles up to 1,000 pounds capacity.

The foregoing indicates the lines on which waste heat is being utilized in brass furnaces. The methods of firing have not been considered, but they include forced draft, the use of solid fuel, gas and oil. In addition to those mentioned, there are other types of excellent furnaces in which the heat is conserved to great advantage.

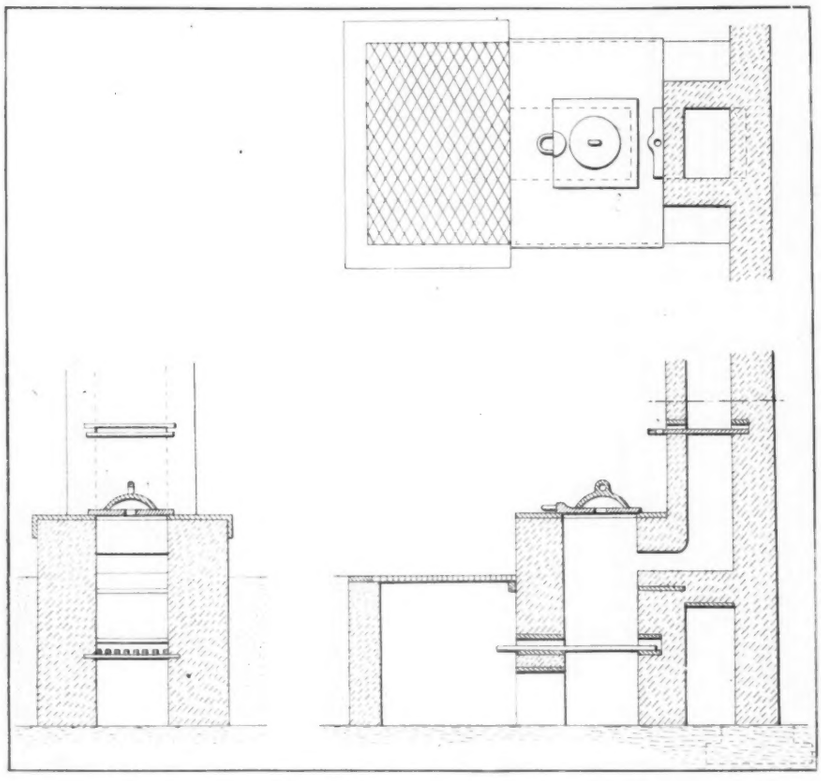


FIG. 8—COMMON TYPE OF COKE-HOLE FURNACE

In a good furnace utilizing forced draft and waste heat, the fuel consumption may be reduced to from 15 to 25 per cent of the weight of coke to metal.

It is probably true that the furnaces utilizing waste heat are approximately 50 per cent more economical of fuel than the ordinary brick furnaces. The first heat made in a furnace is, of course, not a fair test, but it must be included in the remainder of the heats in the day's work, just as the bed charge in a cupola must be taken along with the total coke consumption.

A Morgan furnace, on a one-day test, using a 400-pound crucible, melted 2,420 pounds of gun metal in six heats, with 429 pounds of coke, giving an average weight of metal of

Smith Facing & Supply Co.

The Smith Facing & Supply Co., Cleveland, has been organized to engage in the manufacture of foundry facings and supplies and has purchased the building and machinery of the plant formerly known as the Cleveland Facing Mills and operated by the J. D. Smith Foundry Supply Co. during the last 12 years. The officers of the company follow: Geo. W. Fleig, president; P. G. Smith, vice president, and J. S. Smith, secretary and treasurer.

Melting Losses in the Brass Foundry

In a communication to the members of the American Institute of Metals, H. W. Gillett, chairman of the committee co-operating with the bureau of mines in its investigation of brass melting methods, states that records of crucible life and furnace repairs can be kept most easily by the head furnace tender, whereas attendance costs are best kept by the accounting department. The four great items on which data are desired include fuel, labor and crucible cost, as well as the shrinkage of metal or losses by oxidation and volatilization. Data covering the first three items can be obtained more easily than the fourth. The actual melting loss in furnaces only, is difficult to obtain. If a crucible of metal is poured into many small molds, the oxidation and volatilization during the period of pouring is greater than if poured in a single large mold. Grinding losses are greater on small castings with many gates and sprues than on large castings. These losses are chargeable to the patterns used and not to the furnaces.

One method of obtaining the melting loss only, is to weigh the pouring crucibles or ladles plus the molten metal, from which the weight of the empty ladles or crucibles is subtracted. On the other hand, the castings can be weighed with their attached gates and sprues, but free from core and molding sand, credit being given for both good and defective castings and for any skulls or metal poured into ingots instead of castings. In this case, the furnaces are not credited with recovery of grindings or of anything except skimmings, spillings, etc., obtained in the melting and molding departments.

A less satisfactory, but more common way is to include the grinding losses and credit the furnaces with the weight of good castings, defective castings, gates and sprues and all metal recovered from skimmings, spillings and grindings, the cut-off being made back of the grinding room.

In any case it is essential that the furnaces be debited with all new metals, composition ingot, gates, sprues and large scrap, and borings or grindings received daily from the metal stock room, being credited with any returned unmelted, and with the total castings, gates and sprues produced, as well as with the metal recovered by the recovery department (less the cost of recovery, which can be figured into equivalent pounds

of metal). The value of any tailings, etc., sold also can be converted into equivalent pounds of metal and credited to the furnaces.

On fuel efficiency it makes a difference in heat units required whether new or alloyed metals are used, and the proportions of these and of borings should be known. The tonnage of each different composition should be known, as, for instance, the loss in melting a ton of 8:20 brass and a ton of copper will probably not be the same as in melting 2 tons of 90:10 brass.

First and Last Iron from the Cupola

By W. J. Keep

Question:—We would like to know why the test bars from the first iron in our heat break at from 200 to 500 pounds less than the subsequent bars. The metal from the first tap analyzes as follows: Silicon, 2.37 per cent; manganese, 0.42 per cent; phosphorus, 0.40 per cent; sulphur, 0.103 per cent and combined carbon, 0.90 per cent. The iron from the second part of the heat analyzes as follows: Silicon, 2.24 per cent; manganese, 0.53 per cent; phosphorus, 0.42 per cent; sulphur, 0.091 per cent and combined carbon, 0.46 per cent. The first test bars broke at 2,250 pounds and the second at 2,630 pounds. We would like to know how we can reduce our combined carbon. We light the cupola about two hours before applying the blast and our iron comes down about seven minutes after the blast is off.

Answer:—If you will consult "Cast-Iron," you will find this subject treated at length, including analyses. I discovered these facts in 1894 and immediately changed our foundry methods. Before making these discoveries, we used the first iron for patterns and for our best work, but changed this practice and poured our patterns with the last iron. This phenomenon was disclosed by physical tests, as there is practically no difference in the chemical analysis of the first iron and that later in the heat. The cause of this peculiarity is entirely one of heat treatment.

Hot Cupola

If you will light your fire 2½ hours before the iron is down and if you will heat the bottom and walls of your cupola to a melting temperature before making your first iron charge, the first iron tapped will be much improved. We also add an extra pig or two of silicon iron to the first charge. Notwithstanding all of the precautions you may take, the first iron melted falls on a sand bottom that is not as hot as the iron, which, therefore, boils violently. Furthermore, this iron is tapped into freshly-lined ladles, where it boils again and sometimes after the ladles are dry the iron is poured into other green ladles and from these into the molds. This applies to the first half ton or less of molten iron. After this iron has been tapped, the subsequent metal from the heat will be soft and strong and will have a normal shrinkage. The first iron tapped will have high shrinkage and is liable to be soft on the surface, but white at the center. The first iron from the cupola is never as good as that tapped later and it should be poured into work that is not particular as to quality. You will find that the iron improves in every way as the heat progresses and that the last iron is softest and strongest and has a lower shinkage with substantially the same composition as that prevailing throughout the entire heat.

Pouring Aluminum at a Low Heat

An extensive series of experiments recently was made by H. W. Gillett, at the plant of the Aluminum Castings Co., Detroit, to ascertain the effect of pouring temperature on the strength of aluminum castings. The results were published in the *Transactions* of the Eighth International Congress of Applied Chemistry and the following data have been taken from this report:

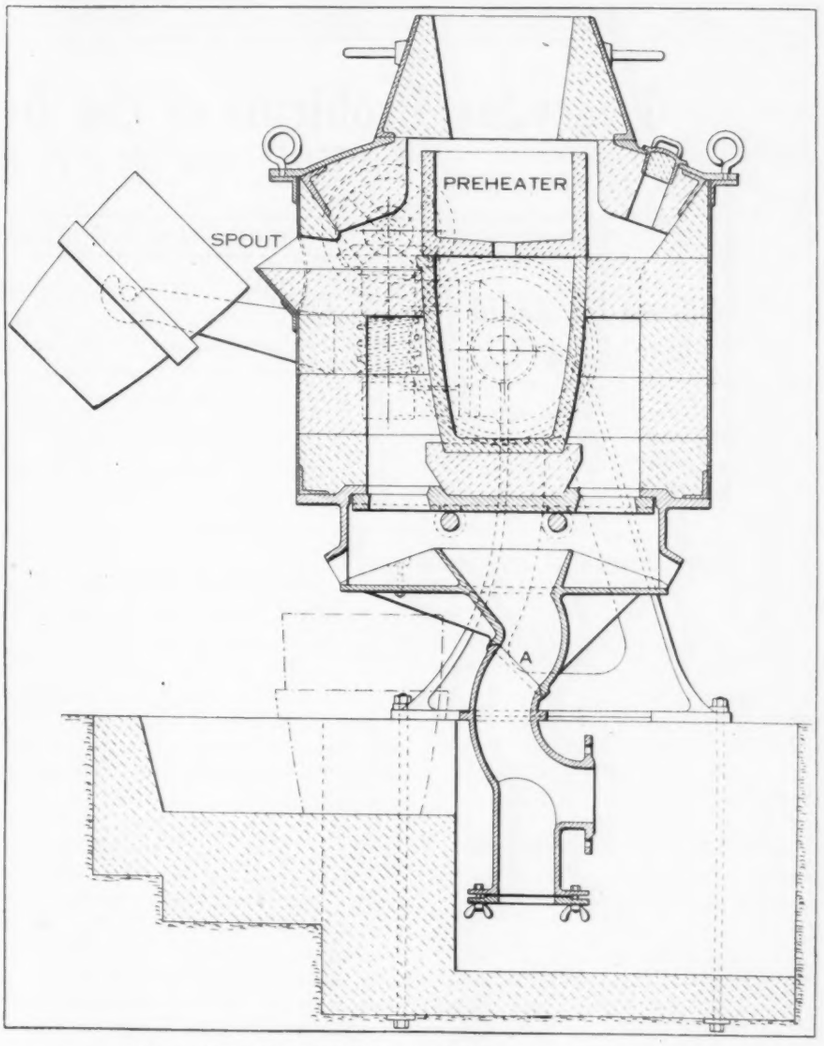


FIG. 9—GERMAN TILTING FURNACE WITH PREHEATER

The tensile strength of aluminum alloys is greatly influenced by the size of the constituent crystals, or as it is termed in the foundry, closeness of grain. The finer the grain, the stronger the metal.

In a series of 53 experiments, the aluminum bars tested averaged nearly 20 per cent stronger when poured cold than when poured hot. Exceptions to these were the alloys of aluminum containing 2 per cent of

manganese and those containing 5 per cent of magnesium. However, the manganese alloy has such a low elastic limit that it is not employed extensively for commercial use. On the other hand, the alloys containing magnesium oxidized so readily when melted that it was found difficult to make castings that did not contain dross.

It was stated by Mr. Gillett that the alloy, consisting of 92 per cent aluminum and 8 per cent copper, is most extensively used at present for making sound castings and easily 90 per cent of the aluminum castings are produced by the use of this mixture. The addition of small amounts of manganese, titanium, iron or antimony to the aluminum and copper alloy previously mentioned, increase the strength of the castings when poured hot, while nickel, chromium, cadmium or bismuth have very little effect on the strength. Any of these elements, however, causes brittleness and decreases the resistance to impact.

The best pouring temperature for the 92 per cent aluminum and 8 per cent copper alloy, as well as other commercial alloys, was found to be 1,225 degrees Fahr. The heat of the bars poured hot averaged from 1,550 to 1,600 degrees Fahr., but these temperatures decrease the tensile strength of the cast bars nearly 20 per cent.

Everyday Problems of the Brass Founder

What To Do and How To Do It

Red Brass for Rapid Machining

We would like to have a red brass mixture suitable for rods which can be machined rapidly, and which is not too soft to permit of hard usage. We have two samples on hand, one being a bronze, which is too tough to be easily machined, while the other is a leaded bronze, which does not withstand the service to which this material is subjected.

The following alloy probably will be found suitable for your work: Copper, 88 per cent; tin, 6.5 per cent; zinc, 3.5 per cent, and lead, 2 per cent.

Another alloy that may be tried follows: Copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent; lead, 3 per cent, and nickel, 2 per cent.

The nickel should be charged into the crucible with the copper, the white metals being subsequently added.

Patching Crucibles

Is there any way of patching a crucible that is still in fairly good shape? Kindly let us know what mixture to employ and how to treat the crucible after it has been patched.

There is no satisfactory method of patching a crucible that has developed a leak, because the new material that may be used to close the opening will not adhere to the graphite walls of the crucible. If the walls of the crucible, however, are not worn through, the life of the pot may be prolonged by first soaking it thoroughly in water and then applying with a brush a mixture of fine carborundum fire sand, china clay and silicate of soda. After the crucible has been patched, dry at a gentle heat. Brush any cracks that may develop with the carborundum mixture and dry again. It is not necessary to anneal the crucible, as it can be used as soon as it is dried. To make a good job of crucible patching requires considerable experience and a knowledge of refractories.

Shotting Alloys

Of the two samples of shot submitted, No. 1 was made in our shop and No. 2 was cast by an eastern company. No. 1 is very dark, having been tarnished, while No. 2 is a beautiful gold color and is not oxidized. We are certain that the ingredients of these alloys are similar. After our alloy is dipped, it develops red oxide spots. What we desire to know is the proper method of pouring a heat for shot similar to sample No. 2, and how to prevent oxidation while pouring. We also would like to know how we can make our shot uniform and of the same size as No. 2, and how it should be dried. Incidentally, we would like to know whether the shot made by the eastern company is dipped. We are of the impression that it has not been plated.

We believe that shot No. 1 has not been poured from a sufficient elevation and possibly the water in the tank into which it was dropped was placid instead of being agitated. The oxidation that occurs during the fraction of a second that the metal is falling through the air should only affect the surface and it can be removed easily by the water or by dipping. The development of red oxide spots after dipping would indicate that the trouble is deeper seated than mere surface oxidation and that it has its origin in the melting furnace. We would suggest, therefore, that careful attention be given the melting and the alloying of the metals. The copper, at all times, should be well covered with charcoal and every effort should be made to prevent oxidation while melting. If exact duplication is desired, it might be advisable to obtain an analysis of shot No. 2, as otherwise there is no certainty that the two alloys will be identical. In alloying, a slight difference in proportioning the component metals will make considerable difference in appearance.

Mixtures for Plumbers' Brass Goods

We manufacture taps, some of which are subjected to high pressure, while others are intended for ordinary use. We would like to know what alloys will give us the best results for both classes of castings. What metals can we add to lead and zinc mixtures that will produce a good yellow alloy?

The only metal that can be used in connection with lead and zinc to produce a good yellow alloy is copper and in this connection, it should be pointed out that the content of the lead must be small as compared with the other metals. An excellent casting alloy follows: Copper, 67 per cent; lead, 3 per cent; tin, 2 per cent, and zinc, 28 per cent.

A somewhat less expensive alloy consists of copper, 67 per cent; zinc, 30 per cent, and lead, 3 per cent.

For a red brass, the following mix-

ture forms an inexpensive alloy: Copper, 84 per cent; lead, 8 per cent, and zinc, 8 per cent. If too soft, it may be hardened by the addition of tin to the alloy. This mixture then will be as follows: Copper, 82 per cent; tin, 2 per cent; lead, 8 per cent, and zinc, 8 per cent.

For high pressure valves an alloy used extensively is made up as follows: Copper, 88 pounds; tin, 10 pounds, and zinc, 2 pounds.

To withstand water pressures the following alloy has proved satisfactory: Copper, 88 per cent; tin, 4 per cent; zinc, 6 per cent, and lead, 2 per cent.

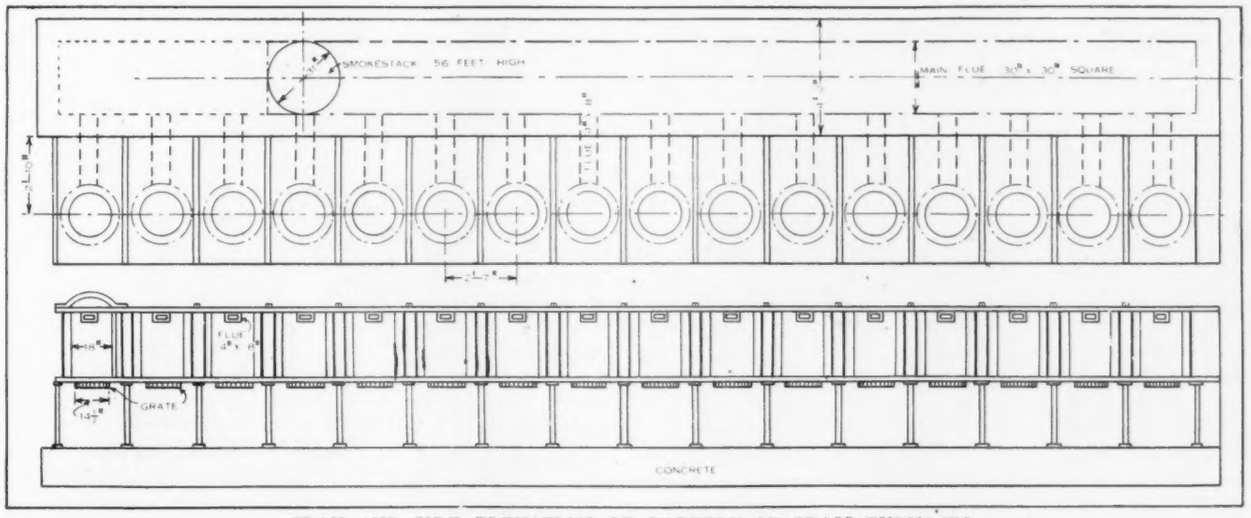
Stack and Flues for Coke-Fired Furnaces

As shown in the accompanying illustration, we are operating a battery of 16 brass melting furnaces, the stack being 36 inches in diameter and 56 feet high. It will be noted that the stack is located directly opposite the fourth furnace of this battery and we would like to know whether it is in the proper position and sufficiently high for a battery of furnaces of this size. Also kindly advise us how many heats these furnaces should produce in a 10-hour day, using No. 80 crucibles and anthracite coal.

Referring to the layout of these furnaces, it seems to us that those at the end of the battery farthest from the flue will not operate satisfactorily. The furnaces which will operate most satisfactorily are the three in front of the stack, as naturally might be expected. The efficiency of natural draft furnaces depends more upon the size of the flues and the shape of the grate bars than upon the height of the stack. In one instance, three 17-inch furnaces with flues 8 x 6 inches were connected with a main flue, 18 x 18 inches, which in turn entered a stack 18 inches in diameter and 30 feet high. Individual grate bars were used, which were loose and could be adjusted as desired relative to the air spaces between them. This furnace easily melted four heats of copper per day and as high as seven heats of brass when scrap metals were used. In the congested business districts of large cities where brass foundries, of necessity, frequently are located on the upper floors of power buildings, it has been found that natural draft furnaces operate efficiently with short sheet iron stacks when they are coupled in pairs, two to a stack. A battery of furnaces thus is transformed into a series of independent units of two furnaces and one short stack. This arrangement eliminates heavy brick flues, as the furnace flues extend directly into the sheet iron stack which rests upon the floor.

The efficiency of the battery furnaces shown in the accompanying illustration would be greatly increased if another stack were added at the opposite end of the battery the same distance from the end as the other stack. The flue should be partitioned in the center, thereby practically making two independent batteries of furnaces. The diameter of the individual flues should be 8 x 6 inches, instead of 8 x 4 inches, and the grate bars, which appear to be of the drop-bottom type, should be cast in steel and should be provided with wide spaces between them. The bars should be as thin as is consistent with the requisite strength. If the flue and grate bar changes are made on the eight end furnaces and if they are cut off from the other furnaces, a sheet iron stack, 40 feet high and 24 inches in diameter, will provide more satisfactory draft and the battery of furnaces will do more work than the other battery equipped with a higher and larger stack.

Coke will be found to be superior to anthracite coal for operating natural draft furnaces. With forced draft, anthracite is economical, as it permits the fuel space between the crucible and the furnace walls to be reduced considerably over that required when using coke. In this instance, however, we would suggest that coke be tried in place of coal.



PLAN AND SIDE ELEVATION OF BATTERY OF BRASS FURNACES

How to Melt Aluminum Turnings and Borings

Kindly advise us how to melt aluminum turnings and borings to the best advantage. We have endeavored to melt these, but find the losses too great.

To recover aluminum borings and turnings, melt ingot aluminum in a crucible until it is about half filled with molten metal and permit the metal to attain a red heat, after which the turnings and borings are charged. These should be stirred into the molten bath until the latter will not dissolve any more of this scrap without becoming pasty. At this stage, close the furnace and permit the metal to again attain a red heat. The surface of the aluminum probably will be in a pasty condition and it will be necessary to use a flux to liberate the aluminum from the alumina. Chloride of zinc should be used for this purpose and about one teaspoonful should be added to a No. 35 or No. 40 pot. If a larger crucible is employed, the amount of chloride of zinc should be increased proportionately. Stir the aluminum after the addition of chloride and the pasty metal will disappear, while the surface of the bath

will become covered with the powder. It is advisable to skim off this powder if it is possible to do so, after which an additional amount of turnings and borings can be added, and this operation can be repeated until the pot is full of metal. The bath again should be fluxed, after which the aluminum is ready to pour. At this stage, the aluminum undoubtedly will carry a considerable amount of nitrogen, which will produce minute pin holes in the castings. Ordinary deoxidizers will be of little value in removing these defects and for this reason the metal should be used for unimportant work which is not finished and in which the strength is of little consequence. The absorption of 0.5 per cent of nitrogen reduces the strength of aluminum alloys more than 50 per cent. As it is practically impossible to prevent the absorption of nitrogen when turnings and borings are remelted, this metal cannot be used for high grade aluminum castings. The only element that will remove nitrogen from aluminum is titanium, which may be added in the form of titanium-aluminum.

Casting Aluminum in Permanent Molds

Kindly advise us what aluminum alloy should be used for casting in chills, iron or steel molds. Also let us know whether magnalium would be suitable for this purpose. We contemplate engaging in the manufacture of miners' pit lamps and the castings will be used for this purpose.

We doubt whether you will be able to cast successfully any alloy of aluminum in permanent molds. If the castings are solid and very simple, the No. 12 alloy, which consists of 92 per cent aluminum and 8 per cent copper, will be found best adapted for this purpose. On the other hand, if your castings are thin and are cored, they will have to be made in green sand molds, preferably with a green sand core. It is probable that trouble from cracking would be experienced by the use of the special alloy which you mention.

Titanium-Copper

Can you give us any information regarding the method of producing titanium-copper?

To make titanium-copper, you should obtain pure Norway rutile, which is a titaniferous ore. Probably it would be more advisable to utilize titanic acid (T_3O_2) free from iron contamination and reduce it at a high temperature with granulated copper. If an alloy is required containing 10 per cent of titanium, use about 20 pounds of rutile to 90 pounds of copper, which will provide a sufficient amount of titanium to compensate for the loss of this metal during the reducing operation. To obtain the necessary temperature to produce this alloy, an electric furnace is required and a powerful reducing agent will have to be employed to reduce the oxygen from the rutile or titanic acid, in order to liberate the titanium in metallic form and to enable it to alloy with the bath of molten copper. The manufacture of titanium-copper is one of the most difficult of metallurgical operations and no amateur could ever hope to succeed in reducing and alloying even the faintest trace of titanium. For this reason, if you desire to experiment with copper or its alloys, it will be necessary to obtain the titanium-copper from the manufacturers of this alloy.

Aluminum Affected by Alkalis

We would like to know what action water containing alkalis will have on the standard aluminum mixture containing 92 per cent of aluminum and 8 per cent of copper. We are designing a device that will come in contact with the water from a boiler and we are wondering whether the action of this water on aluminum will disintegrate the metal. While this metal is not immersed in the water, nevertheless, it comes in contact with it in alternate periods of one-half hour.

We believe that you will find that an alloy containing large percentages of aluminum will not be adapted for this purpose, as this metal is disintegrated rapidly by alkalis. Furthermore, we believe that the intermittent contact with the water will prove more severe than complete immersion. We suggest the substitution of a bronze containing only a small percentage of zinc or of Monel metal.

Alloying Lead With Copper

To what extent can lead be alloyed with copper without the addition of other metals? Can a composition of 80 per cent copper and 20 per cent lead be cast in a sand mold and insure solid, clean castings?

Lead alloys with copper to a very limited extent only, but it can be held in suspension in almost any proportion, even to the extent of a reversal of the percentages which you give. An alloy of 80 per cent copper and 20 per cent lead would be greatly improved by the addition of about 5 per cent tin, as otherwise it would be too soft for the majority of purposes. The usual method of holding the lead in suspension is by the use of sulphur, although some fluxes will accomplish this work much better than is possible by the use of sulphur. Up to 30 per cent lead, the addition of tin is all that is required to hold the lead in suspension, but after the 30 per cent limit has been passed, the lower the percentage of tin in the mixture, the more easily it will hold the lead. For this reason an alloy of 50 per cent copper and 50 per cent lead is used extensively for casting purposes.

Oxidation Difficulties

We are manufacturing a line of brass work for mining machinery, but the castings are porous. We use a large amount of scrap brass and copper wire to which we add lead, tin and zinc in sufficient amounts to hold the scrap to practically the original formula. We melt with a natural gas furnace, although originally we used a natural-draft, coke furnace. Our trouble seems to date from the change in our furnaces.

Your trouble is caused by excessive oxidation brought about by the maintenance of an oxidizing flame in the furnace. The proportions of air and gas are not properly regulated, too much air being driven into the furnace, which results in a large excess of oxygen, some of which combines with the metal and produces an aerated condition of the castings. We would suggest that the blast be reduced or the gas supply increased. This may result in a longer melting period or a larger consumption of gas, but it will prove more economical. When operating oil or gas furnaces for melting non-ferrous metals, it is a good plan to maintain considerable pressure in the furnace and consequently the opening should be small. This practice prevents the volatilization of the metals to a large extent, confines the heat and favors the economical use of a reducing flame instead of a strongly oxidizing flame.

Black Products Co.

The Millers' Products Co., Chicago, manufacturer of core compounds, has been succeeded by the Black Products Co., which will operate the Millers' Products Co.'s plant, at Chicago, and also a new works of large capacity recently completed at Philadelphia. William M. Wilson, Chicago, has been appointed general traveling representative and Urban W. Frink, of Boston, has been appointed New Engalnd sales manager.

How We Cast 22 Cylinders in One Sand Mold

Details of an Exceedingly Remarkable Foundry Achievement, With a Description of the Mold Used and Method of Casting

By George W Kelly

ABOUT 14 years ago we began making experiments to produce a sand mold from which more than one casting could be made. The section with which the experiments were conducted was a cylinder for a machine used for pressing cotton into bales, which has largely replaced the old type screw press. In Fig. 2, 22 of these castings are shown, which were made in one mold.

The cylinder has a 30-inch bore, is 7 feet, 7 inches long and a metal thickness of 1¼ inches in the rough is provided throughout. The cylinder has an external flange and supports on one end, and an internal flange at the other end. This internal flange makes it possible to lift out the casting without tearing the face of the mold.

As shown at the right, Fig. 1, a sectional flask is employed for the cylinder mold. Its inside diameter is about 4 inches greater than the outside diameter of the pattern and this allows 2 inches of sand between the pattern and the flask. The pattern is a ring, 33 inches in outside diameter by about 20 inches deep. For centering the flask, a smooth board is provided with pin holes to fit pins on the flask section. The pattern is centered on the board by wooden blocks, which are fastened to the board and which fit inside of the pattern ring.

In making the mold, one section of the flask is placed on the board and the pattern is set over the center blocks. The sand is then filled in and rammed, the pattern being drawn out and the flask lifted off, the same as in ordinary molding practice. The flask then is placed on three iron stools, which are of sufficient height to permit a molder to get into the mold. Each succeeding section is made in the same way, being placed upon each other until the cheek is completed. The drag, which is a loam plate, is shown at *A*, Fig. 1. The flask sections are bolted together and a molder gets inside of the mold to smooth the joints between the successive sections.

The core is made on a cast iron barrel wound with hay rope and coated with loam. Both the core and the mold are carefully blackened and dried, after which the mold is closed, placed in a pit and poured. After pouring, the casting is left in the mold over night to cool. On the following morning, the casting will be very hot, but will have contracted sufficiently to permit lifting it out of the mold. After the removal of the casting, the mold is raised from the pit, the bottom, or drag plate, is taken off and the mold is again placed on the iron stools. The burned blacking is removed with a soft brush and a new coating is applied, the mold then being placed in the oven to dry.

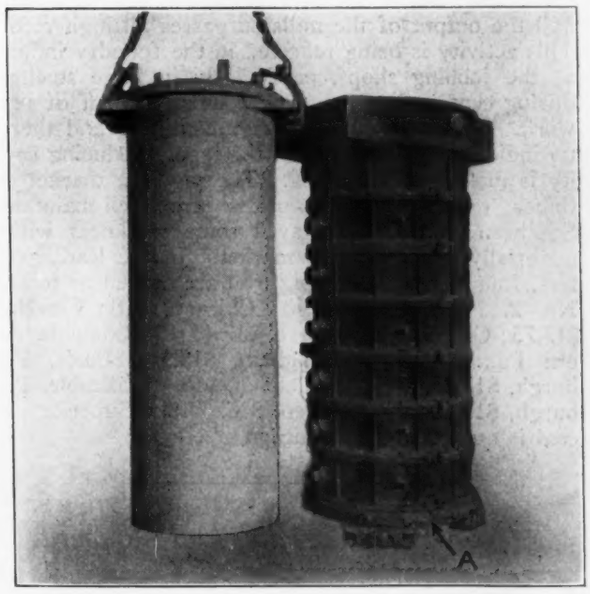


FIG. 1—CASTING AND SECTIONAL MOLD EMPLOYED

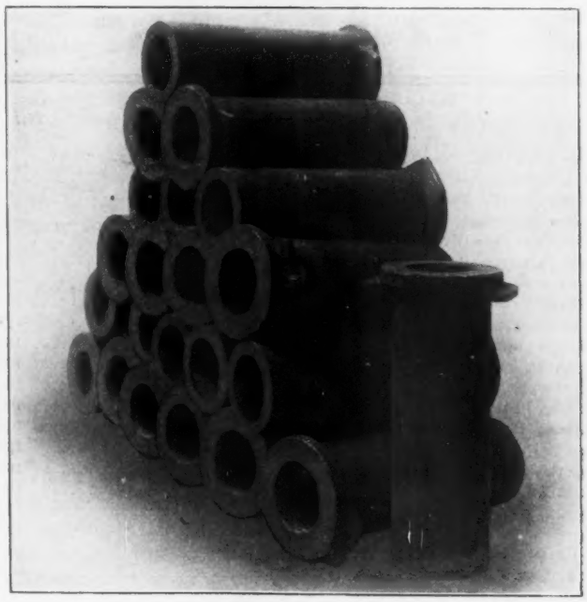


FIG. 2—CYLINDERS MADE FROM ONE MOLD

In addition to the obvious economy afforded by getting several castings from one sand mold, there is the additional saving of about three-quarters of the fuel ordinarily required to dry the mold for each succeeding casting. Our experience has shown us that the second and third castings are smoother than the first, or than any succeeding castings formed in one mold. Each time that the mold is used after the fourth casting, it appears to disintegrate rapidly until the seventh or eighth, when it begins to solidfy and this continues until the surface appears glossy. We believe

(*Continued on page* 125)

THE FOUNDRY

A monthly journal devoted to all branches of the foundry business.

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG. - - - - Prince's Chambers
CHICAGO - - - - - - 1328 Monadnock Block
CINCINNATI - - - - - 503 Mercantile Library Bldg.
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SUBSCRIPTION

United States and Mexico - - - - - - $1.00 a year
Canada - - - - - - - - $1.50 a year
Great Britain and other Foreign Countries - Eight Shillings
Single Copies - - - - - - - - 15 cents

Copies published three months or more previous to date of current issue, 25 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances etc., must be received on the 10th of the month preceding date of publication.

ENTERED AT THE POSTOFFICE AT CLEVELAND AS SECOND CLASS MATTER

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Trade Outlook

TRADE conditions in all branches of the foundry industry continue satisfactory, but quotations for castings are being advanced slowly. Prices, unfortunately, have not kept pace with the increased cost of labor and materials and many foundrymen are still operating on a basis that nets only a minimum profit. The volume of new business in all of the leading casting centers makes it possible to obtain orders at higher prices than have been prevailing, yet the low quotation is ever-present and reflects a lack of knowledge on the part of the foundryman making this minimum price, of how to estimate the selling price of his product. To some extent, the output of foundries is being curtailed by the scarcity of skilled labor and that the remuneration of the finished foundry mechanic will continue on a constantly-ascending scale is indicated by the lack of interest in the training of apprentices that is manifested in many shops. Common labor is more plentiful than for many months, but the number of available men will decline with the advent of spring and the opening of the building season. Steel and malleable foundries are crowded for deliveries and the situation will become more acute when the large tonnage of castings for recently-contracted car work is placed. The anticipated lull in the steel trade has not materialized and the output of the mills surpasses all high records. This activity is being reflected in the foundry industry, as the jobbing shops, particularly in large steel producing centers, are receiving a large amount of repair work. The aluminum shortage continues and there is no indication of relief until the ingot producing capacity is materially increased. The pig iron market continues quiet, although prices are well-maintained. Southern iron has displayed some weakness without materially unsettling the market. In the leading centers, foundry grades of pig iron are quoted as follows: No. 2, Pittsburgh, $18.40; Chicago, $18; Cleveland, $17.75; Cincinnati, northern, $17.45; Philadelphia, eastern Pa., $18.25; Birmingham, $13.50. Basic, Pittsburgh, $17.25, and Philadelphia, $18. Malleable, Pittsburgh, $18.50, and Chicago, $18. Lake Superior charcoal is quoted at $18, Chicago.

Non-Ferrous Alloy Development

CONSIDERING the number of new metallic elements that have become available for the brass founder in recent years, it is surprising, in view of their constantly expanding field of usefulness, that no alloys have been developed of the same general character as the copper-tin series. Phosphor bronze continues today, as in the past, to be the strongest red alloy. Its maximum tensile strength may be placed at 40,000 pounds per square inch and its elongation may range from 15 to 20 per cent, figures easily exceeded by the strong copper-zinc alloys, such as manganese, tobin and other so-called bronzes, but which, in reality, are brasses. The red metals or bronzes occupy a sphere of their own quite distinct from that of the brasses, and the latter alloys only can be substituted therefor to a limited extent, as they lack the anti-frictional and excellent casting qualities that distinguish the copper-tin alloys and which make them so valuable for non-ferrous ma-

chinery castings. No element has yet been found that can take the place of tin for forming alloys with copper, or that is capable of improving the physical qualities of these alloys to a greater extent than phosphorus. The value of manganese in high zinc alloys is well known. Aluminum and silicon, as well as some of the other elements, also confer valuable properties, but when added to bronze the results are unsatisfactory in every case, which nullify every advantage arising from their use. Aluminum, manganese and nickel alloy readily with copper, and form excellent combinations, which, however, lack casting qualities. The difficulties attending the casting of aluminum bronze have practically banished this alloy from the foundry in spite of its superior physical qualities and comparatively low cost. Both manganese and nickel form white alloys with copper, which, however, are difficult to cast without the addition of aluminum, coupled with skillful manipulation. Other elements, such as magnesium, silicon, titanium, chromium, calcium and sodium, are incapable of forming alloys with copper, that can in any way compete with bronze, and it appears, therefore, that no alloy will ever be discovered to take its place, unless some method is discovered of treating aluminum bronze that will remove its casting difficulties. It is more than probable, therefore, that future developments in the production of strong alloys, other than those of copper and zinc, will be in the direction of white alloys, produced by the addition of manganese or nickel to alloys of copper with small percentages of other metals. For the production of strong, nonferrous alloys, nickel is peculiarly adapted, as it alloys readily with copper, and in this direction its use is steadily increasing. For bearing alloys, manganese is more suitable than nickel when added in sufficient quantity to whiten the alloy, as the combination can carry a high percentage of lead.

Hammering the Market

A MANUFACTURER of heavy machinery, operating a large steel foundry, recently decided to have analyses made of all of the supplies used in the casting department of his plant. One of the first products analyzed was adulterated about 35 per cent of its weight by a mineral substance which could not possibly improve its quality and the properties it should possess for the work for which it was intended. The price at which this material was purchased was about 25 per cent lower than the prevailing quotation on similar products of known purity. In this case the amount of the adulterant almost represented the difference in prices, but the dealer insured an additional profit for himself by a proportionate increase in the amount of foreign material. In the long run, we usually get what we pay for. This applies equally to the purchase of foundry materials. In his zeal to obtain the lowest possible prices, the purchasing agent frequently oversteps the bounds which separate a pure product, sold at a profit, from an adulterated material quoted on a much lower basis. In a market of free competition a product generally sells for what it is worth and it should be stated in this connection that a fair price usually begets quality.

Brass Melting Methods

BRASS foundry losses, in many instances, can be traced directly to faulty melting methods, and if the melter is not to be blamed, improper furnace construction may be held accountable for the porosity of the castings, and a number of other ills, which add to the misery of the brass founder's daily existence. The work undertaken by the Bureau of Mines and the special committee appointed by the American Institute of Metals at the Buffalo meeting, should be productive of excellent results and no doubt will disclose many facts which are hidden mysteries to the average melter. The questions, as compiled and submitted to brass foundrymen throughout the country, are exceedingly comprehensive and every phase of melting practice is considered. Many interesting suggestions are contained in this circular and if the brass foundrymen will co-operate, it can be safely predicted that wonderful strides in brass foundry melting practice will be made during the next few years.

Estimating the Selling Price

AT A RECENT meeting of the Buffalo Foundry Foremen's Association, a class was conducted in estimating the selling price of castings. The members in attendance at this gathering were asked to estimate the cost of molding, coremaking and the weight of a water jacket chest for a gas engine, and to facilitate the making of estimates, a blue print of the casting was provided with a pattern and a set of cores. The weight of the casting was 125 pounds, although it was variously estimated from 60 to 175 pounds. The estimates made by the various foundrymen in attendance are shown in the following table:

Estimate No.	Molding Cost, Cents.	Coremaking Cost, Cents.	Weight, Pounds.	Selling Price Per Pound, Cents.
1	32	22	108	5.70
2	30	60	60	3.90
3	100	125	95	3.50
4	75	50	140	5.00
5	90	50	100	6.00
6	60	50	70	4.50
7	60	25	125	4.60
8	60	60	60	3.25
9	80	45	175	10.00

The results obtained indicate the necessity for education among foundrymen along the lines of estimating the selling price of castings. They prove conclusively that many foundrymen estimate the selling price by guesswork and that they do not pursue a logical method for obtaining the desired result. The variations in the weight of the casting are striking, particularly in view of the fact that this can be obtained accurately by fixed formulae. The wide variation in the molding cost naturally was expected, although a spread of from 30 cents to $1.00 reflects a lack of knowledge on the part of the estimators as to the time required for making a mold and the difficulties involved. The cost of coremaking varies more widely than that of molding and the estimates range from 22 cents to $1.25. The selling price shows a spread of 3.25 cents to 10 cents per pound. It is certain that the foundry endeavoring to do this work at 3.25 cents would lose heavily, whereas the shop bidding 10 cents for this class of work would rarely obtain an order. A fair estimate for the cost of a casting of this kind is 5 to 6 cents per pound, although much lower prices are being quoted by some shops, which evidently compensate this loss on other classes of work.

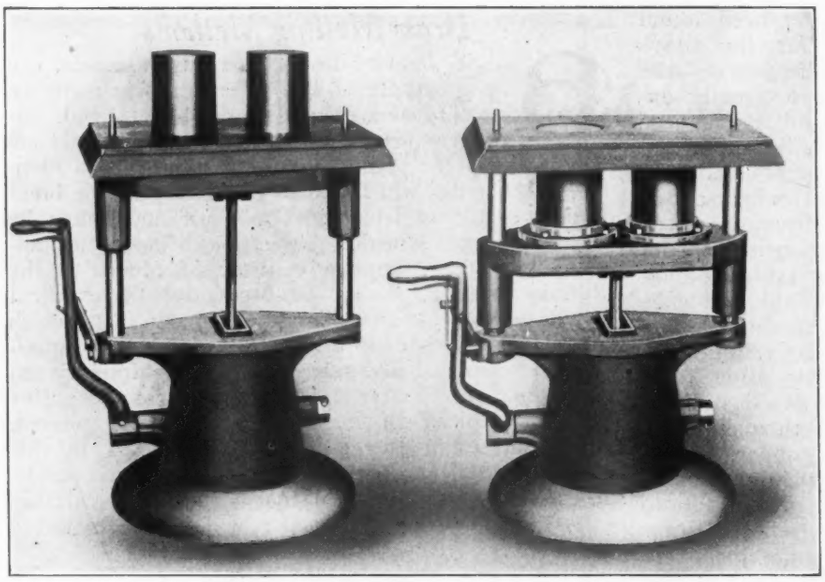


FIG. 1—PISTON MOLDING MACHINE FOR MAKING DRAGS; AT THE LEFT THE PATTERN IS IN POSITION TO RECEIVE THE FLASK AND AT THE RIGHT THE PATTERN HAS BEEN LOWERED AWAY FROM THE MOLD

Piston Molding Machine

A molding machine, specially designed for making gasoline engine pistons and other similar cored, cylindrical castings, is being built by the Affiliated Manufacturers, Milwaukee. The general features of the device are shown clearly in the accompanying illustrations. Ordinarily, pistons are molded in single flasks with dry sand cores. The core is provided with suitable recesses to form the hubs or bosses constituting the wrist pin bearings. The Affiliated Manufacturers' machine is designed to make the entire mold with green sand.

The machine for making the drag half of the mold is shown in Fig. 1. At the left, the machine is in position to receive the flask and at the right the pattern has been stripped from the mold. The cope machine is illustrated in Fig. 2. The machine at the left is in position to receive the flask, while at the right the pattern has been lowered away from the mold. The cope machine is provided with plungers operated by the lever, *A*, Fig. 2, which are used to form the impression for the wrist pin hubs. If the piston is of the type which has a reinforcing ring on the inside near the wrist pin bearings, the proper impression in the core for this ring also may be produced by the operation of the plunger mechanism. In this case the ring pattern is split and is attached to the dogs which form the wrist pin impressions. A reinforcing ring at the lower end of the piston can be formed by the use of a separate aluminum pattern ring which comes out of the machine with the mold and is subsequently drawn from the sand.

The machine can be arranged to handle pistons of any size, but the standard type is designed for a maximum diameter of 6 inches. The machines weigh 600 pounds per pair and are said to be very rapid in operation. It is claimed that in a foundry in Oshkosh, Wis., a pair of these machines enabled one operator to make 200 flasks per day, each containing two pistons. The molds are made in special cast iron flasks which are accurately fitted to the machine. The iron is fed through a double skim gate and no riser is used.

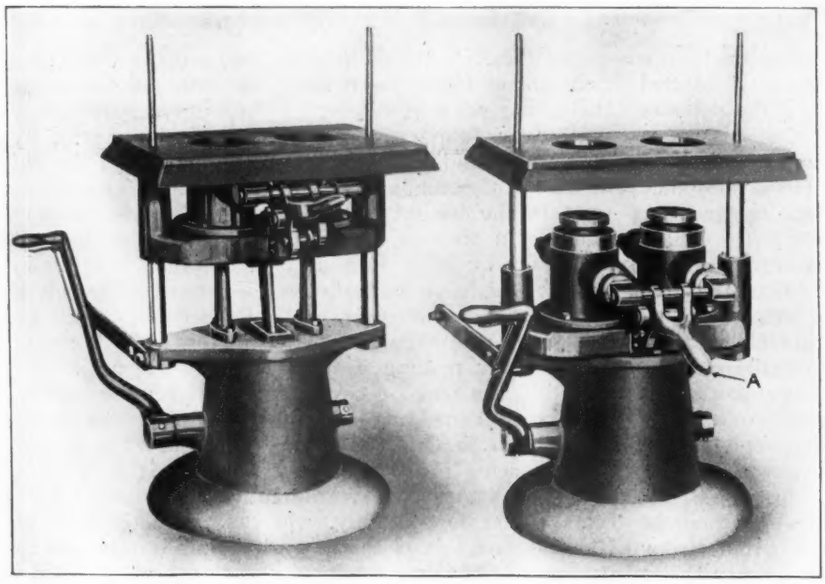


FIG. 2—MACHINE FOR MAKING THE COPE; AT THE LEFT THE PATTERN IS RAISED IN MOLDING POSITION AND AT THE RIGHT THE PATTERN HAS BEEN STRIPPED

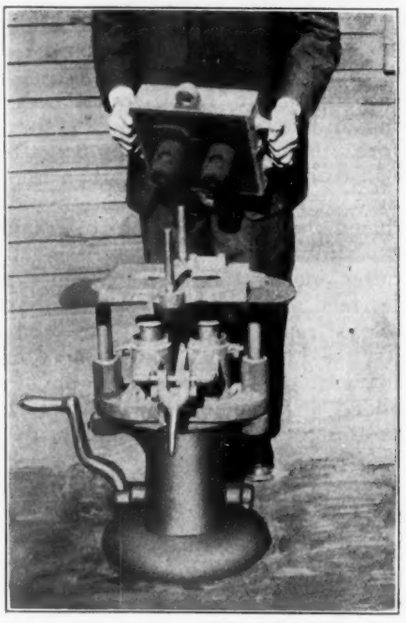


FIG. 3—COPE MADE ON PISTON MACHINE, SHOWING GREEN SAND CORES

A specially-prepared oil for making sand mixtures for matches is now being offered to the foundry trade by the Crawford Oil & Chemical Co., Cleveland. This product has been used extensively in malleable shops and in a number of gray iron foundries. It is claimed that the first sand match was made from boiled linseed oil about 38 years ago.

Among the Men in the Foundry Trade

Where They Are and What They Are Doing

Edgar W. Cohoon, of Bristol, Conn., has been appointed foreman of the Collins Foundry, Collinsville, Conn.

David Spence has been appointed superintendent of the new foundry operated by the King Sewing Machine Co., Buffalo.

Albert Pendlebury, formerly of Batavia, N. Y., has been appointed foundry foreman of the Grote Mfg. Co., Evansville, Ind.

W. A. Riddell, superintendent of the steel foundry of the Otis Steel Co., Cleveland, severed his connection with that company on Feb. 15.

William James has been appointed foundry foreman of the casting plant operated by the Walworth Mfg. Co., South Boston, Mass.

Herman Dehn, formerly connected with the Speich Stove Co., Milwaukee, has been appointed superintendent of the foundry of the Giddings & Lewis Co., Fond du Lac, Wis.

J. C. Garrard has resigned from the Griffin Wheel Works, Chicago, to accept the position of superintendent of the plant of the Northwestern Malleable Iron Works, Milwaukee.

J. F. Cady, core room foreman of the foundry operated by the Kissel Motor Car Co., Hartford, Wis., has been appointed foreman of the foundry operated by this company.

John Prinze, formerly foundry superintendent of the Standard Sanitary Mfg. Co.'s plant, at Louisville, Ky., is again associated with the Henry Vogt Machine Co., of that city.

W. McEvoy, manager of the Iron, Concrete & Asbestos Mfg. Co., Durbin, Natal, South Africa, is on an inspection tour of the foundries of the United States and Canada.

John Pinkerton, formerly connected with the Newport News Ship Building Co., Newport News, Va., has been appointed superintendent of the foundry operated by the Epping-Carpenter Co., Pittsburgh.

George A. Burman, one of the sales representatives of the Peterson National Co., Chicago, has resigned and has accepted a position with the Crawford Oil & Chemical Co., Cleveland, manufacturer of core oils.

Hugh McPhee, of the Tarrytown Aluminum & Bronze Foundry, Tarrytown, N. Y., was severely injured by an explosion of molten aluminum in his shop. As a result of the accident, he will lose the sight of one eye.

J. W. Bass, foundry expert employed by the Globe Malleable Iron & Steel Co., Syracuse, N. Y., has resigned and has accepted the position of foundry superintendent of the Oneida Foundry Co., Oneida, N. Y.

H. S. Vrooman, Fisher building, Chicago, recently tendered his resignation as a director of the Chicago Foundrymen's Club, and H. Cole Estep, associate editor of THE FOUNDRY, has been elected to fill the vacancy.

A. M. Frauenheim has been appointed manager of the Philadelphia office of the Herman Pneumatic Machine Co., Zelienople, Pa. The office of this company is at 905 Stephen Girard building.

James R. Petley, assistant treasurer and purchasing agent of the National Brake & Electric Co., Milwaukee, has resigned to become associated with L. R. Riebs, manufacturers' agent, Milwaukee.

H. T. Taylor, traveling representative of the Hill & Griffith Co., Cincinnati, has resigned and has accepted a position with Frederic B. Stevens, Detroit. Mr. Taylor will represent Mr. Stevens in Michigan and western Pennsylvania.

B. F. Evans, who has been general foreman of the foundry operated by the Delaware, Lackawanna & Western Railroad Co., Scranton, Pa., has accepted the position of general foundry foreman of the American Locomotive Co., with headquarters at Dunkirk, N. Y. Mr. Evans entered upon his new duties on Feb. 17.

E. H. Mansfield, formerly associated with the Pittsburgh Crushed Steel Co., Pittsburgh, is now associated with the Thomas W. Pangborn Co., Hagerstown, Md., in the capacity of traveling representative in the New England territory, with headquarters at Springfield, Mass.

John Hill, president of the Hill & Griffith Co., Cincinnati, and one of the organizers of this firm, has resigned, but as his plans for the future are indefinite, he will take a much needed rest. The Hill & Griffith Co. was organized in 1895 by John Hill and T. L. Griffith, the latter having retired seven years ago. Prior to the organization of this company, Mr. Hill was affiliated with the S. Obermayer Co., Cincinnati, for a period of 13 years. For practically 31 years he has been engaged in the foundry supply and equipment business and he is known to the trade throughout the United States. E. T. Richards succeeds Mr. Hill as president of the Hill & Griffith Co.

Casting 22 Cylinders in One Mold

(Continued from page 121.)

that this is due to the heat first breaking down the particles of sand and afterward melting and reuniting them.

The first time this experiment was attempted, two castings were obtained from one mold. For some time we continued getting two castings for each mold until we again began experimenting to improve the process and in August, 1906, obtained 14 cylinders from one mold. Following this, in July, 1910, we succeeded in casting 22 cylinders, in one dry sand mold. The lot of cylinders made in this mold is shown in Fig. 2.

While still in a very hot condition, the casting is lifted out of the mold by a crane, as shown at the left, Fig. 1. This, however, could not be accomplished if the cylinder had external flanges on both ends. A new core is made for each casting, as it can be used only once. Only a small amount of plumbago is applied to the mold after the first cast, as the pores of the sand are thoroughly filled with this facing when the mold is painted. Approximately 4,000 pounds of metal are required for each casting. The metal is dropped into the mold through nine square gates and the first metal entering drops 8 feet, this being the distance from the bottom of the runner box to the bottom of the mold. Into the mold in which 22 cylinders were cast, 88,000 pounds

of metal were poured. It can readily be appreciated that the method of pouring the castings is a severe test for a mold, yet by exercising care it was possible to repeat this pouring operation 22 times.

Our opportunity to experiment with this work is limited, as our shop is located in an agricultural community. In this district many castings of plain design are made, to which this process might be applied.

A Refractory Cement

Until recently, fire clay has been used almost exclusively for building brick walls, cementing joints, patching and lining furnaces, kilns, retorts, etc., where high temperatures are encountered. The fire clay generally is mixed with a binder. The H. W. Johns-Manville Co., New York City, now is manufacturing a high temperature cement which, it is claimed, can be used to good advantage where working temperatures range from 1,500 to 3,100 degrees Fahr. This material is in the form of a dry powder, consisting of asbestos and other ingredients. It is mixed with water to the proper consistency in the proportion of 18 to 20 pounds of water to 100 pounds of powder, for use as a mortar or for tamping around molds. When air-dried, this cement will withstand a crushing strain of 883.5 pounds per square inch. It vitrifies at the comparatively low temperature of 1,480 degrees Fahr., and its melting point is 3,182 degrees Fahr. Being semi-acid in character, it can be used with chrome, silica or fire clay brick.

Trade Notes

The H. W. Johns-Manville Co., New York City, has established a branch office in the Dooly Block, Salt Lake City.

The Albany Sand & Supply Co., Albany, N. Y., miner and shipper of molding sands, is sending an exceedingly useful calendar to the trade, the date pad of which is 16 x 20 inches.

Spencer Kellogg & Sons, Buffalo, manufacturers of linseed and other oils for foundry use, offer the services of their well-equipped laboratory, free of cost, to foundrymen desiring tests of core oils.

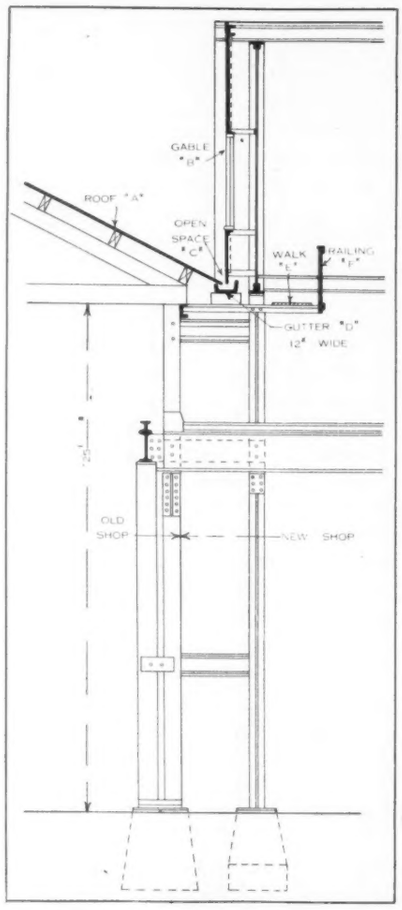
The Peterson-National Co., Chicago, manufacturer of core oil, dry core compound and parting, with plants at Buffalo and Chicago, is now operating its new dry core compound and parting plant recently built at Buffalo.

A Leak-Proof Gutter

By Thos. D. West

Trouble with leaky skylights and gables led the author to devise the gutter shown in the accompanying illustration. This construction was used in connecting a wing to the main shop of the West Steel Casting Co., Cleveland, and has now successfully withstood the test of snow storms, sleet, and heavy rains, without a drop of leakage having escaped from the opening, *C*. Details for this arrangement were furnished by architect Frederick Baird.

The main shop and the new wing are each about 52 feet wide and about 25



CROSS-SECTION OF BUILDING, SHOWING NOVEL GUTTER CONSTRUCTION

feet high in the clear under the trusses. As shown in the accompanying illustration, the iron sheeting of the roof at *A* is not carried down to a connection with the siding of the gable at *B*, and, therefore, an open space is left at *C*. Under the open space *C*, is placed the gutter, *D*. The opening *C* is about 3 inches wide, and the gutter, which is constructed of No. 18 gage sheet metal, is 12 inches in width. The gutter has a fall of 6 inches in the width of the building, and at the lower end is connected with a 6-inch downtake which runs the water into the city sewer.

For convenience in cleaning the gutter or repairing it if necessary, the footwalk shown at *E*, was provided. The railing, *F*, was added as a guard. With this gutter design, either the gable sheeting or the roofing may be repaired independent of each other. Of course this construction leaves an opening in the roof of the shop, but in foundries such ventilation is not objectionable at any time of the year.

Use of Pyrometers

The use of pyrometers is increasing among malleable and brass founders, although the development is slow and is the result of much painstaking effort and education on the part of the manufacturers. There is no question now as to their value, nor as to the necessity that exists for them in foundries. This is evidenced by the installations made of late years by the larger and better known foundry interests. It is an entirely different and much more difficult problem, however, to convince operators of small foundries that these instruments in reality constitute a necessity and not a luxury, incident to the high quality demanded in present-day foundry products.

As an illustration of this, the Thwing Instrument Co., 445 North Fifth street, Philadelphia, recently outfitted the Pennsylvania railroad shops at Altoona, and West Philadelphia, Pa., and Trenton, N. J., with 15 pyrometers. While the smaller foundrymen are slower to avail themselves of the advantages of scientific instruments, such as these, the Thwing company reports that its business shows a gratifying increase.

Weekly Shop Meetings

J. N. Korhumel, foundry manager of the Rutenber Motor Co., Logansport, Ind., has had considerable success with a policy of holding weekly conferences of the various foremen in the shop. These meetings are held in the evening and are conducted along parliamentary lines. The various problems which arise in the shop are discussed and there has been an appreciable improvement in the co-operation between departments since this plan was put into effect. After the business session, an hour or more usually is devoted to general sociability, at which time light refreshments are served.

What the Foundries Are Doing

Notes of the Gray Iron, Steel, Malleable and Brass Shops

The Montague Iron Works, Montague, Mich., has been acquired by Martin Hausler and James D. Wilson.

The M. Rumely Co., La Porte, Ind., has purchased the plant, assets and business of the Northwest Thresher Co., Stillwater, Minn.

The Peacock Iron Works, which has been operated at Selma, Ala., for over 50 years, will be moved to Attalla, Ala.

The gray iron foundry operated by Yost Bros., Creighton, Pa., recently was completely destroyed by fire, entailing a loss of approximately $15,000.

The St. Louis Steel Foundry, St. Louis, operated by the Curtis & Co. Mfg. Co., has been incorporated and hereafter will be known as the St. Louis Steel Foundry Co.

The Badger Foundry Co., Racine, Wis., recently completed the erection of a large addition to its plant, which includes a machine shop, pattern shop and office building.

The Richmond Radiator Co., New York City, has acquired the plant of the Reading Radiator Co., Reading, Pa. Grant Nagle and D. L. Adams will serve as local managers.

The Wehr Steel Casting Co., Milwaukee, manufacturer of crucible steel castings, has placed an order with the Whiting Foundry Equipment Co., Harvey, Ill., for the installation of a side-blow converter.

The Brennan-Smyth Steel Casting Co., 2284 Scranton road, Cleveland, has been incorporated with $200,000 capital to engage in the manufacture of steel castings. Two side-blow converters will be installed.

The Standard Steel Casting Co., Cleveland, which acquired the plant of the Superior Drop Forge Co., contemplates the installation of a side-blow converter and will engage in the manufacture of steel castings.

The foundry of the Bolivar Foundry & Machine Co., Bolivar, Pa., was wrecked recently by a hurricane. The plant is being rebuilt and it is expected that operations will be resumed at an early date.

The Holbrook-Armstrong Iron Co., Racine, Wis., has enlarged its foundry capacity by the erection of an addition, 60 x 80 feet, and the melting capacity will be increased by the installation of a Whiting cupola.

The Kalamazoo Stove Co., Kalamazoo, Mich., will erect a one story shop for its hot air furnace department to be used as a warehouse and tin shop. A three-story salesroom and office building also will be built.

The National Cast Iron Pipe Co., Birmingham, Ala., is ready to receive bids for a foundry building of steel and brick construction. This company has completed its pipe plant and has placed orders for pattern shop machinery, pumps, etc.

The Washington Iron Works, Seattle, Wash., manufacturer of mill, mining and marine machinery, is installing a 3-ton Girod electric furnace in its new foundry. This will be the first electric steel casting plant on the Pacific Coast.

The Burr Co., Champaign, Ill., is building a foundry, 132 x 50 feet, with two wings, each 35 feet long. In addition, a separate brick office building and pattern shop, 37 x 100 feet and two stories in height, has been completed.

The contract for the erection of a new foundry for the Atlantic Foundry Co., Cleveland, has been awarded. The plans, which were prepared by the Osborn Engineering Co., provide for a one story building of brick and steel, to be 110 x 220 feet.

The Standard Steel Castings Co., Cleveland, will erect a pattern shop, 40 x 60 feet, and a fire-proof pattern storage, 24 x 30 feet. The pattern shop will be modernly equipped and will engage in the production of patterns for the trade.

The Milwaukee Steel Foundry Co., Milwaukee, has increased its capital stock from $10,000 to $150,000. The additional capital will not be expended for the erection of additions to the plant or the purchase of new equipment, as has been reported.

The Huntington Machine & Foundry Co., Huntington, Ind., has been incorporated with a capital of $125,000 to engage in the operation of a foundry and machine shop. The incorporators are Christian Heinss Sr., H. E. Oskamp, V. A. Heinss, Edwin B. Ayres and F. E. Wiekerhiser.

F. & E. Trump, Jersey Shore, Pa., have been succeeded by a corporation which will be known as F. & E. Trump, Inc. The officers of the company are Frank Trump, president; J. Howard Patterson, vice president, and E. D. Trump, secretary and treasurer. The original firm operated the plant since 1884, making a general line of gray iron and brass castings. The new firm anticipates a continuance of the business on somewhat broader lines than in the past.

The Bellefonte Engineering Co., Bellefonte, Pa., has taken over the plant of the J. Howard Lingle Co. and will engage in general foundry and machine shop work. In addition, this company will manufacture steam hammers in 10 sizes from 25 to 500 pounds. Gas engines also will be built. The officers of the company are C. A. Roberts, president, and Victor E. Rehr, secretary and treasurer. Mr. Roberts and Mr. Rehr were connected with the National Transit Co., Oil City, Pa., for several years.

At a meeting of the stockholders of the New York Central Iron Works Co., Hagerstown, Md., directors were elected as follows: M. P. Moller, Samuel Emmert, Thomas W. Pangborn, D. A. Stickell, O. D. McCardell and John G. Ernst. The following officers were elected: M. P. Moller, president; Thomas W. Pangborn, vice president and general manager; C. E. Williams, treasurer, and M. T. Kelleher, secretary. In addition to manufacturing heating boilers, this company builds a large line of special plate and tank work.

The Hamilton Malleable Iron Co., Hamilton, Ont., has been organized with a capital of $600,000 to engage in the manufacture of malleable castings for railroad and agricultural work. Three sites are being considered and a plant, which will cost approximately $250,000, will be built. J. E. Hammond, formerly manager of the Brantford, Ont., plant of the Pratt & Letchworth Co., Ltd., is one of the directors of the new company and will assume the management of the foundry. The temporary office of the Hamilton Malleable Iron Co. is in the Sun Life building, Hamilton.

The Peru Castings & Machinery Co., Peru, Ind., has purchased the foundry and machine shop formerly occupied by the Otis Elevator Co., that city. The new company will engage in the manufacture of gray iron and semi-steel castings, either rough-machined or assembled, and the plant will be placed in operation about April 1. The officers of the company follow: C. E. McCampbell, president; R. M. Carter, vice president, and I. H. Barbee, secretary and treasurer. Mr. McCampbell is superintendent of the foundry, Mr. Carter is supeintendent of the machine shop and Mr. Barbee is mechanical engineer.

At the annual meeting of the Atlantic Radiator Co., of Huntingdon, Pa., E. M. C. Africa, Joseph Bancroft, Richard C. Schwoerer, F. A. Downes, Albert C. Stein, George L. Townsend Jr. and Judson A. Goodrich were elected directors, R. C. Schwoerer, president; Judson A. Goodrich, vice president; E. M. C. Africa, treasurer; Albert C. Stein, assistant treasurer, and J. B. Bairn, secretary. Judson A. Goodrich, general manager, will continue the execution of the plans for the enlargements and improvements which have been in progress for some months. This company is in the market for new core room equipment, including ovens and cars, a new cupola and also machine shop trucks.

New Construction

Willis McPherson has announced his intention of building a foundry and machine shop at Fredericton, N. B., Can.

The American Rotary Valve Co., Anderson, Ind., is building a foundry, 40 x 90 feet, and will shortly install a three-ton crane.

The Modesto Mfg. Co., Modesto, Cal., contemplates the erection of a foundry and machine shop at an approximate cost of $20,000.

The Otis Elevator Co. will erect an addition to its foundry at Buffalo, which will be 107 feet wide and 400 feet long. Green & Wicks, Buffalo, are the architects.

The Old Colony Foundry Co., East Bridgewater, Mass., manufacturer of iron and brass castings, will erect an addition, 100 x 42 feet. Contracts for the building have been awarded.

The John B. Morris Foundry Co., Cincinnati, has purchased an additional lot, 37 x 105 feet. The additional space will be utilized for an extension to the cleaning and chipping departments.

The National Cast Iron Pipe Co., Birmingham, Ala., has received bids for the construction of its main foundry, which is to be of structural steel and brick. Orders have been placed for pattern shop machinery.

The New Departure Mfg. Co., Bristol, Conn., manufacturer of hardware specialties, will add two stories to its three-story office and factory building, which is 215 x 62 feet.

The company also operates a foundry and plating department.

The Cribben & Sexton Co., Chicago, manufacturer of stoves, will erect a building, 100 x 150 feet and five stories high.

Plans have been completed for the new machine shop and foundry to be erected by the Heaps Engineering Co. on Lulu Island near New Westminster, Man., Can.

The soil pipe plant of the Southern Pipe & Foundry Co., Birmingham. Ala., recently destroyed by fire, will be rebuilt. The loss is estimated at $75,000.

The National Sanitary Mfg. Co., Salem, O., is planning extensions to its enameled sanitary ware plant. A bond issue of $125,000 will be made to provide funds for extensions.

The Hempfield Foundry & Machine Co., Greensburg, Pa., has been acquired by a group of Pittsburgh men. Plans have been prepared for the erection of new buildings which will double the size of the plant and provision is being made for the installation of electric cranes and an additional cupola.

The Lewisburg Foundry Co., Lewisburg, Tenn., has been organized with $50,000 capital to engage in the operation of a gray iron foundry. The equipment of the plant of the Sheffield Foundry Co., Sheffield, Ala., will be removed to Lewisburg. W. T. Archer is vice president and general manager.

R. B. Carolin, who was formerly foreman of the brass foundry of the Clayton & Lambert Mfg. Co., Detroit, has started a jobbing foundry for the manufacture of aluminum, brass and bronze castings. The firm is not incorporated and the business will be conducted under the name of R. B. Carolin. The foundry is located at 825-835 Superior street, Detroit.

Among Brass Founders

The Galion Brass & Bronze Foundry Co., Galion, O., will shortly erect a new plant.

The Bronze Metal Co., Meadville, Pa., will erect a foundry, machine and pattern shop, 100 x 190 feet.

The Zenith Carburetor Co., 262 Jefferson avenue, Detroit, contemplates the installation of a brass foundry in its works.

The brass and aluminum foundry, operated by the Buick Motor Co., Flint, Mich., recently was destroyed by fire, entailing a loss of $50,000.

The Dominion Hose Coupler Corporation, Buffalo, has been incorporated and will engage in the manufacture of hose couplings and other similar brass goods.

The Rochester Brass & Aluminum Co., Rochester, N. Y., contemplates the erection of a new foundry, two stories high, which also will contain a machine shop.

The Ohio Brass & Copper Co., Cincinnati, shortly will move into its new plant at 412 Elm street. Sufficient equipment is being added to double the present output.

The recently incorporated Victor Brass Mfg. Co., Cleveland, is now operating. The officers of the company are L. J. Brennan, president; M. J. V. Moran, vice president; N. J. McGrath, secretary and treasurer, and J. H. Lyons, general manager. This company will manufacture a general line of high grade plumbers' brass goods.

An addition has been completed to the plant of the Columbia Castings Co., Detroit, which doubles the capacity of the shop. Aluminum castings for automobiles and motor cycles are produced.

The Lorain Brass & Bronze Foundry Co., Lorain, O., is building a new plant at Washington avenue and the Nickel Plate railroad, in that city, for the manufacture of brass, bronze and aluminum castings. E. M. Gable is general manager.

Thomas Savill's Sons, Philadelphia, manufacturers of plumbers' brass goods, will erect a two-story brass foundry upon property recently purchased at Wallace and Watts streets. The shop will be 32 x 40 feet and the wing, 36 x 40 feet.

The Indianapolis Aluminum Castings Co., Indianapolis, recently organized, has purchased the plant of the American Brass & Aluminum Co. and is installing a large amount of new machinery. A specialty will be made of the manufacture of aluminum castings.

The Cast Aluminum Ware Co., Preston, Ont., recently has been organized to engage in the manufacture of aluminum cooking utensils. Plans have not yet been prepared for the buildings or their equipment. A. N. W. Clare, Preston, is one of the organizers of the new company.

The Meadville industrial committee has agreed to furnish a site for a new plant to be constructed at Meadville, Pa., by the Bronze Metal Co., 30 Church street, New York City. This company has plants at Meadville and Hillburn, N. Y., which will be combined in the Meadville plant. The present building plans provide for a structure 90 x 200 feet, with a saw-tooth roof and one story high.

The James-Edwards Bronze Works, 3134 Penn avenue, Pittsburgh, is now operating a pattern shop at Heron and Ridgway streets, that city. This company produces valves, bushings, gear wheels, composition castings and aluminum, white metal and brass pattern plates. Mr. James, of this company, was formerly secretary and treasurer of the Superior Bronze Co. and Mr. Edwards was connected with the Fort Wayne, Ind., shops of the Pennsylvania railroad.

The Werra Aluminum Co., Waukesha, Wis., has been organized by Conrad Werra and A. Pankratz with a capital of $110,000 to engage in the manufacture of aluminum castings. The shops of the Wisconsin Central Railway Co., abandoned three years ago, have been leased and the buildings are now being altered for foundry purposes and contracts are being placed for equipment. Mr. Werra established the Aluminum Foundry Co., at Manitowoc, 14 years ago. In 1909 this plant was purchased by the Aluminum Castings Co., Cleveland. Mr. Werra continued as general manager and Mr. Pankratz as superintendent.

New Trade Publications

GRAPHITE PRODUCTS. — The Joseph Dixon Crucible Co., Jersey City, N. J., has issued a very complete catalog illustrating and describing a wide variety of graphite products. Crucibles, devices for the introduction of phosphorus into molten metal, black lead, flake and lubricating graphites and numerous other similar articles constitute a few of those listed.

PNEUMATIC HAMMERS.—An illustrated catalog, describing pneumatic riveting, chipping and calking hammers, has been issued by the Chicago Pneumatic Tool Co., Chicago. Descriptions and dimensions of various styles of hammers are given and also a table of dimensions of rivet sets and other tools for use with the hammers. The catalog closes with a short article on the care of pneumatic hammers, pointing out many ways in which they are often thoughtlessly abused.

METAL MELTING FURNACES. — The Hawley Down Draft Furnace Co., Easton, Pa., has issued an illustrated catalog presenting the merits of the Hawley, mechanically-operated, tilting converters and furnaces. The adaptability of this furnace for use in plants which at times require small heats is explained and also its availability for refining and recarbonizing processes. Tables of dimensions and capacities, together with cross-sectional views showing the method of construction of the furnace, are given.

ROTARY GAS PRODUCERS.—A gas producer, which embodies the unique construction of two vertical shells rotating in opposite directions, is described and illustrated in a 24-page catalog issued by the Chapman Engineering Co., Mt. Vernon, O. The fuel in this producer rests directly upon the revolving fire bed and the rotation of the upper and lower sections of the fuel chamber serves to compact the entire body of the charge and prevents the formation of blow-holes or the scaffolding of the heated coal on the walls.

PYROMETERS.—Two bulletins, issued by the Thwing Instrument Co., Philadelphia, describe radiation pyrometers and recorders. One of these bulletins is largely devoted to a reprint of a paper from the Journal of the Franklin Institute, in which the theory of the radiation pyrometer is explained and the laws governing its action outlined. Several testimonials are also included. The bulletin devoted to recorders presents a specimen record showing how, by the use of this mechanism, as many as three continuous records may be taken on one sheet. By the use of a recorder it is possible to know definitely at what temperatures the furnace operated at all times.

METALS AND ALLOYS.—The Goldschmidt Thermit Co., New York City, in a 32-page booklet describes its various metals and alloys which are produced free from carbon by the thermit process. All of the alloys, with the exception of ferro-alloys, are produced technically free from iron and other impurities. The alloys made by this company include ferro-titanium, containing 25 per cent titanium; chromium, 98 to 99 per cent chromium; ferro-chromium, 75 per cent chromium; chromium-manganese, 30 per cent of chromium and 70 per cent of manganese; chromium-copper, 10 per cent chromium; chromium-molybdenum, 50 per cent chromium; manganese, 97 to 98 per cent; manganese-copper, 30 per cent manganese and 70 per cent copper and also 16 2/3 per cent manganese and 83 1/3 per cent copper; manganese-titanium, 30 per cent manganese and 35 per cent titanium; manganese-tin, 50 per cent manganese; manganese-zinc, 20 per cent manganese; manganese-boron, 30 to 35 per cent boron; ferro-vanadium, 30 to 35 per cent vanadium; ferro-molybdenum, 80 per cent molybdenum, and ferro-boron, 20 to 25 per cent boron. A large amount of valuable data regarding the properties of these alloys are contained in this catalog.